Chicago Regional Energy Snapshot

Profile and Strategy Analysis

Prepared for the Chicago Metropolitan Agency for Planning

CNTenergy

September 2009

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The Regional Energy Snapshot is one strategic area of *GO TO 2040*, the region's comprehensive planning effort for metropolitan Chicago produced by the Chicago Metropolitan Agency for Planning (CMAP). The resulting *GO TO 2040* plan will guide growth in the seven-county region[1] for years to come. In addition to land use and transportation, the plan also addresses quality-of-life issues including economic development, housing, education and the natural environment. All of these areas play a role in energy consumption in the region.

Over the next thirty years, the Chicago metropolitan area will experience growth in population, and likewise, in energy consumption. However, as we increase our awareness on the harmful effects of unchecked growth in energy consumption, energy conservation becomes more crucial in not just improving, but preserving our current quality of life.

The Regional Energy Snapshot is made up of two parts, first the Regional Energy Profile, which depicts energy consumption in the region as it is today and establishes a baseline from which to build[2], and the Regional Energy Strategies Analysis, which assesses potential strategies that, if implemented, can reduce energy consumption across the region.

Energy Consumption

In this first component, the Regional Energy Profile discusses the importance of understanding energy consumption and its connection to greenhouse gas emissions. This establishes context to analyze regional and county natural gas and electricity consumption data by sector (residential and commercial industrial) and vehicle miles traveled data. Six individual municipalities were also examined to provide context at a local level; please see Appendix A to review this report.

In 2005, the region consumed 546 billion KBTU (Kilo British Thermal Units) in natural gas and 292 billion KBTU in electricity, totaling 837 billion KBTU consumed across the region. At the county level, energy consumption has a direct relationship with population size. Cook County with the majority of people, 62% of the region's population, consumed 64% of the region's total energy consumption. In comparison, McHenry County, which makes up four percent of the region's population, consumed three percent of the region's total energy consumption. However, analysis of energy consumption at the household level depicts how consumption varies across the region, distinguishing which areas are more efficient. Household analysis also includes vehicle miles traveled (VMT), which generally concludes the farther out the county is from downtown Chicago/Cook County, the higher the annual VMT per household.

1 Cook, DuPage, Kane, Kendall, Lake, McHenry and Will Counties.
2 Data reflects consumption in 2005.

Energy Strategies

Once an understanding of energy consumption in the region is established, the Regional Energy Strategies Analysis takes a look at various energy strategies to reduce consumption; thereby, reducing cost and the region's carbon footprint. After an explanation of several *GO TO 2040* alternative scenarios, energy strategies are categorized according to the Regional Scenarios and further analyzed, addressing energy reductions and cost savings at a per unit basis, and then at different scales of deployment within the region. A strategy matrix provides a comprehensive summary of the various strategies and potential benefits.

Regional Energy Profile

Introduction

In this first component of the Regional Energy Snapshot, the profile illustrates how understanding the connection between energy consumption and greenhouse gas emissions is pivotal in seeking to reduce the region's carbon footprint. This correlation establishes context to then examine how energy is consumed region-wide today, as well as in individual counties. This analysis includes natural gas and electricity consumption data by sector and vehicle miles traveled data. At the end of the profile, a brief summary of the six individual municipalities examined to provide context at a local level is included. See Appendix A to review the full municipal reports.

Understanding Energy Consumption

Natural Gas

Natural gas is consumed primarily for the purpose of space heating, but includes other uses like hot water heaters, clothes dryers and cooking appliances. In the CMAP region, the residential consumers outweigh commercial and industrial (C&I) in consumption with 57% of the region's natural gas consumption attributed to the residential sector. Overtime as the region grows, so does our natural gas consumption. However, on the household (HH) level, residential natural consumption has been decreasing slightly over time as homes become more efficient. Natural gas is measured in therms; the KBTU conversation factor is 1 therm equals 100 KBTU.

It should be noted that within the data sources for natural gas, "transport gas" amounts to a small portion of total natural gas consumption. Transport gas is simply gas that passes through the pipelines in the region for sales by third party suppliers. In some cases it is consumed in the region, and in other cases, it is merely passing through to other areas of the state and beyond. Determining how much transport gas is burned and used within the region can only occur with distribution usage data provided by each utility. For the purposes of this report, only transport gas consumed within the region has been included in the analysis.

Electricity

Electricity consumption occurs primarily by air conditioning, utilization of lights, and all electrically powered appliances, with refrigerators being one of the most consumptive. Both commercial and residential consumption is on the rise nationwide. "In the residential sector, a proliferation of consumer electronics and information technology equipment has driven much of the growth. In the commercial sector, telecommunications and network equipment and new advances in medical imaging have contributed to recent growth in miscellaneous electricity use."[3] In the CMAP region, the commercial and industrial sector accounts for about 2/3 of all electricity consumption. Electricity is measured in kilowatt hours (kWh); the KBTU conversation factor is 1 kWh equals 3.412 KBTU.

3 Energy Information Administration: "Miscellaneous Electricity Services in the Buildings Sector", AEO2007 http://www.eia.doe.gov/oiaf/aeo/otheranalysis/mesbs.html

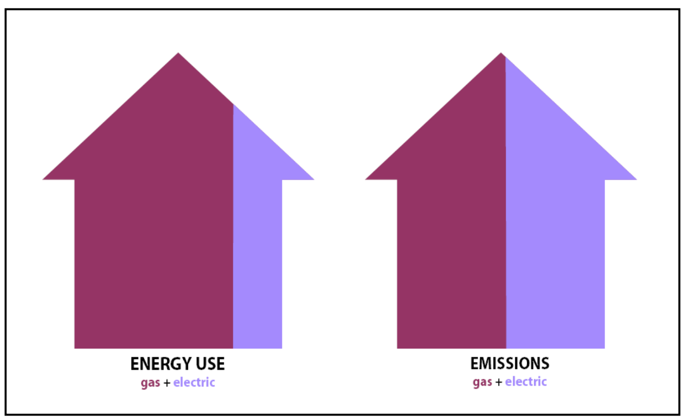
The connection between energy and emissions

Most of the world's energy comes from the burning of fossil fuels that include coal, petroleum, and natural gas. Fossil fuels are made up of hydrogen and carbon, and when they are burned, the carbon combines with oxygen and creates carbon dioxide, one of the greenhouse gases. Other major energy sources include nuclear power and renewable energy from wind, solar, biomass or hydroelectric. Most energy sources are used for specific purposes. For example coal, nuclear, wind and biomass are used for making electricity, while petroleum is used primarily for transportation (with only small amounts used for electricity generation). Finally, natural gas is used in two ways, as an end use fuel for heating homes and business and in industrial process, but also as a fuel source for the generation of electricity.

However, all energy is not created equal, so to speak. The actual amount of carbon dioxide produced for any given unit of energy depends on the carbon content of the fuel since "the combustion of coal adds a significant amount of carbon dioxide to the atmosphere per unit of heat energy, more than does the combustion of other fossil fuels."[4] Coal emits nearly two times the carbon dioxide per unit of energy when compared to natural gas, while crude oil combustion falls between the two. In Illinois, electricity is largely generated from coal-fired and nuclear plants with some renewables, and some natural gas used for peak power generation. The Chicago region's electricity comes from the wider electric grid covering parts of the Midwest which has a higher concentration of coal. In contrast, the northeast United States has significant natural gas base load generation and very little coal, while the northwest has significant hydro-electric generation.[5] In short, because of the mix of regional generation sources, electricity consumption in Illinois has a higher rate of emissions compared to petroleum (transportation sector) or natural gas than it might in other areas of the country.

Figure 1 shows the comparison of a household's energy consumption in Kilo British Thermal Units (KBTU), which allows therms and kilowatt hours to be compared with the same unit of energy. Note that although nearly 75% of household energy consumption can be attributed to natural gas usage and only the remainder to electricity, almost half of household emissions are due to electricity consumption.

Figure 1. Comparison of Household Energy Use and Emissions



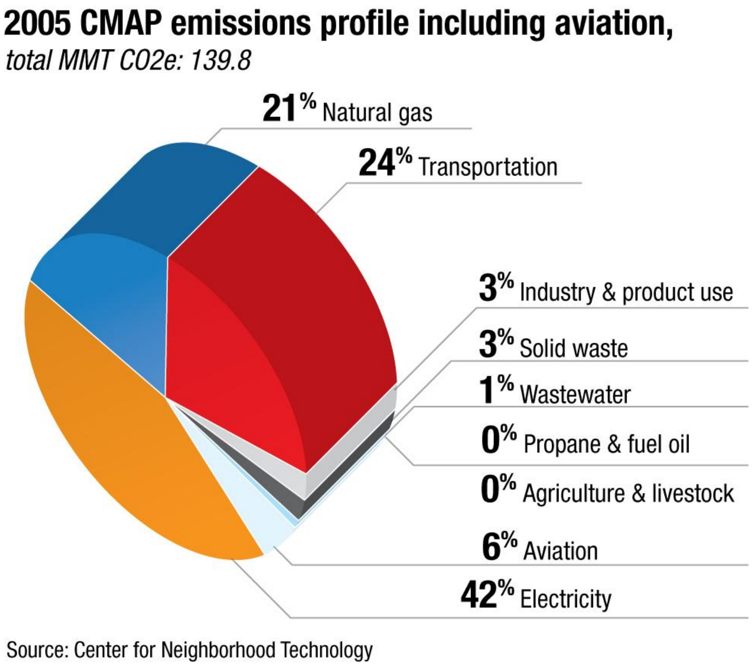
4 Energy Information Administration: "Greenhouse Gases, Climate Change, and Energy," May 2008

5 The Changing Structure of the Electric Power Industry 2000: An Update, Chapter Three. http://www.eia.doe.gov/cneaf/electricity/chg_stru_update/chapter3.html

The importance of understanding energy consumption

According to a recent emissions study in the CMAP region, energy consumption in buildings makes up about 63% of total greenhouse gas emissions. Another 24% can be attributed to transportation. (Figure 2.) These emissions are rising steadily, like elsewhere in the nation and worldwide, and will continue to do so if current behavior and policy trends continue. If we seek to reduce our emissions with mitigation strategies, understanding our energy consumption patterns becomes imperative, since the consumption of energy is a major component of our region's emissions profile.

Figure 2. 2005 CMAP Region Emissions Profile



Energy Consumption in the Region

The CMAP Region

The following table and figures describe total energy consumption in buildings in the seven-county region. The data has been converted to KBTU in order to compare all energy consumption. A more detailed description of natural gas and electricity consumption follows in the subsequent sections.

Table 1. Regional Energy Consumption (Natural Gas and Electricity) 2005, KBTU

	KBTU		
	Residential	Commercial & Industrial	Total
Cook	262,582,417,985	268,026,017,907	530,608,435,892
DuPage	39,958,454,815	54,950,386,435	94,908,841,250
Kane	19,123,131,312	26,948,096,683	46,071,227,996
Kendall	3,798,980,196	3,498,376,510	7,297,356,707
Lake	36,601,161,281	31,824,150,382	68,425,311,663
McHenry	14,149,208,717	12,831,365,934	26,980,574,651
Will	25,791,946,830	37,688,420,178	63,480,367,007
Region	402,005,301,137	435,766,814,030	837,772,115,167

Figure 3 and 4 depict the proportional relationship between energy consumption and population. However, Figure 5 below illustrates how energy consumption varies in households across the region.

Figure 4. Energy Consumption as % of Region

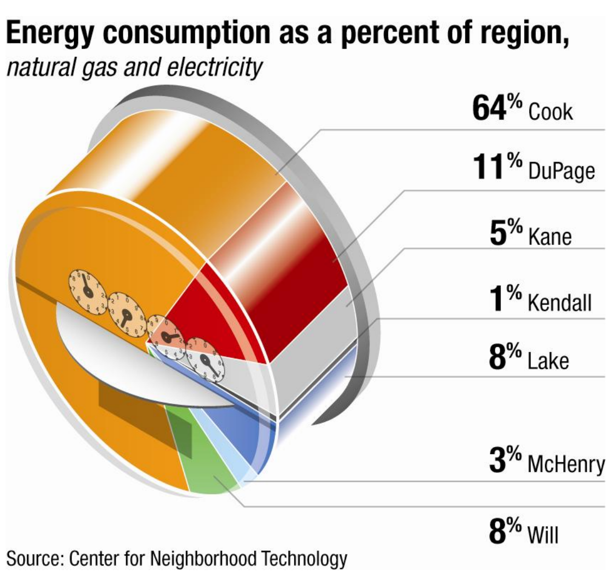


Figure 3. Population as % of Region

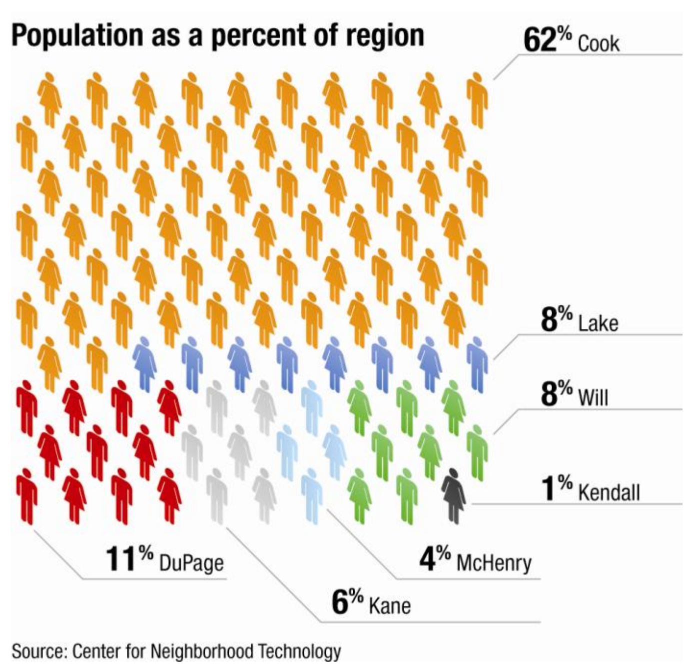
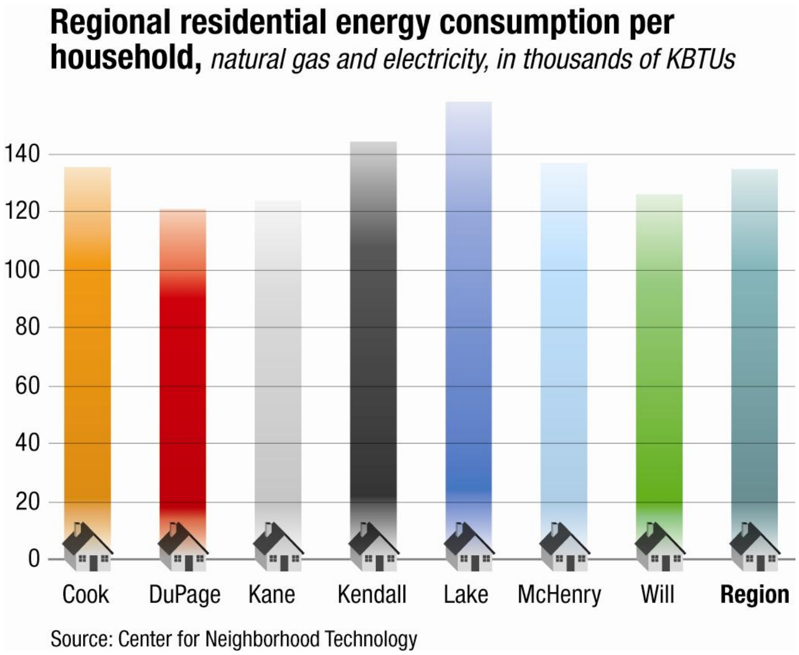


Figure 5. Regional Residential Energy Consumption per HH (Natural Gas and Electricity)



Natural Gas

Total Consumption, county breakdown + by sector

In 2005, the amount of natural gas consumed in CMAP region was 5.4 billion therms (5,460,400,368). Consumption amounts are directly related to each county's rank in population size, which is not surprising. (Figure 6 and Table 2.)

Figure 6. County Natural Gas Consumption as % of Region

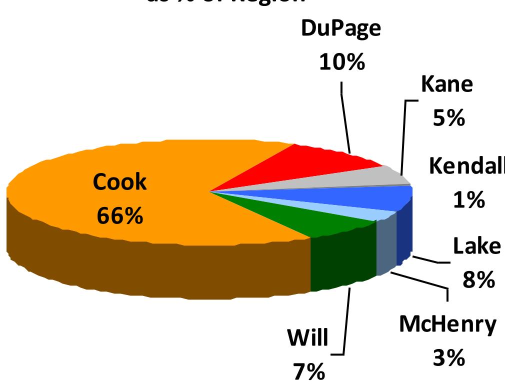


Table 2. County Natural Gas Consumption and Population

Rank	Rank by Population Size	Rank by Natural Gas Consumption (therms)
1	Cook	3,565,888,888
2	DuPage	551,843,159
3	Lake	425,822,712
4	Will	401,485,665
5	Kane	292,265,089
6	McHenry	174,814,538
7	Kendall	48,280,317

Sources: 2005 Consumption Data, Nicor, Peoples Gas and North Shore Gas; and the U.S. Census Bureau, 2005 American Community Survey.

In 2005, fifty-seven (57%) percent of the region's consumption occurred in the residential sector. (Table 5 and Figure 7.) This makes sense given that natural gas is primarily used for residential purposes such as space heating, hot water heaters, clothes dryers and cooking appliances. Average annual consumption per household in the CMAP region is

1,044 therms, which amounts to approximately $1,224 annual natural gas expenses per household.[6] (Table 6.) This number is simply an average and varies in each household depending on factors including building size, age of the building and building envelope efficiencies, the efficiency of the furnace/boiler and water heater. These influencing factors are applicable across all geographies. Please keep these influential variables in mind while reading the report. See Table 3 and Table 4 below to examine housing age and type across the region. Older homes and buildings will likely use more natural gas due to generally being less efficient. Where as smaller homes/buildings will use less natural gas; particularly relevant to multifamily buildings.

Table 3. Housing Age by % of Total Housing Stock for County and Region

Housing Age	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will	Region
Built 2005 or later	1.1	1.2	3.1	11.1	2.4	4.2	4.4	1.7
Built 2000 to 2004	3.9	6.0	14.6	29.7	11.3	15.2	21.1	7.0
Built 1990 to 1999	5.7	15.5	17.7	17.8	19.9	24.7	24.4	10.5
Built 1980 to 1989	6.9	18.2	9.6	6.0	14.8	13.3	8.7	9.2
Built 1970 to 1979	12.8	25.4	15.2	14.5	16.6	14.6	15.2	14.8
Built 1960 to 1969	13.3	13.5	10.4	7.3	10.1	6.7	8.8	12.4
Built 1950 to 1959	16.4	11.4	9.8	3.7	11.4	8.3	7.3	14.2
Built 1940 to 1949	8.9	2.9	4.3	1.4	4.0	3.2	2.8	7.0
Built 1939 or earlier	30.9	5.9	15.2	8.4	9.5	9.7	7.3	23.3

Source: 2005-2007 ACS

Table 4. Housing Type by % of Total Housing Stock for County and Region

Housing Type	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will	Region
1-unit, detached	40.5	60.3	68.8	74.8	67.8	78.2	74.4	50.0
1-unit, attached	5.5	12.2	9.1	15.1	11.2	9.6	11.7	7.5
2 units	10.8	0.7	4.6	0.7	2.8	1.6	2.2	7.8
3 or 4 units	11.4	2.8	4.6	1.5	3.1	2.6	2.4	8.5
5 to 9 units	9.4	6.1	4.7	2.2	3.1	3.7	2.0	7.6
10 to 19 units	5.2	7.1	3.1	2.9	4.2	2.1	2.7	4.9
20 or more units	16.5	10.6	4.4	2.7	5.8	1.7	3.1	12.9
Mobile home	0.7	0.2	0.7	0.0	1.9	0.6	1.6	0.8

Source: 2005-2007 ACS

6 Illinois Commerce Commission Utility Sales Statistics for 2005 were used to calculate average cost and as such, dollar amounts reflect a snapshot in time. As energy prices continue to fluctuate, it may be important to recalculate average cost per household. It should also be noted that there are other rate structures that may significantly influence household average cost, too.

Table 5. County Natural Gas Consumption and Population

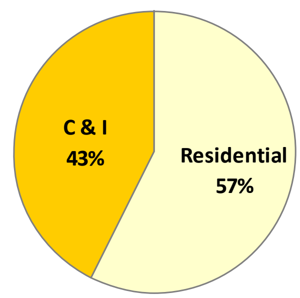
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Region	3,122,788,780	57	2,337,611,588	43	5,460,400,368

Table 6. Regional Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Region	1,044	$1,224

* 2,989,996 HH (2005 – 2007 ACS)

Figure 7. Regional Natural Gas Consumption by Sector



Each county varies in how its sectors consume natural gas, and the consumption reports for each individual county explore them in more detail. Below, Figure 8 and Table 7 show natural gas consumption by sector in the counties at a glance, and for quick comparison purposes Figure 9 provides context by displaying residential natural gas consumption per household by county.

Figure 8. Region and County Natural Gas Consumption by Sector as % of Total Consumption

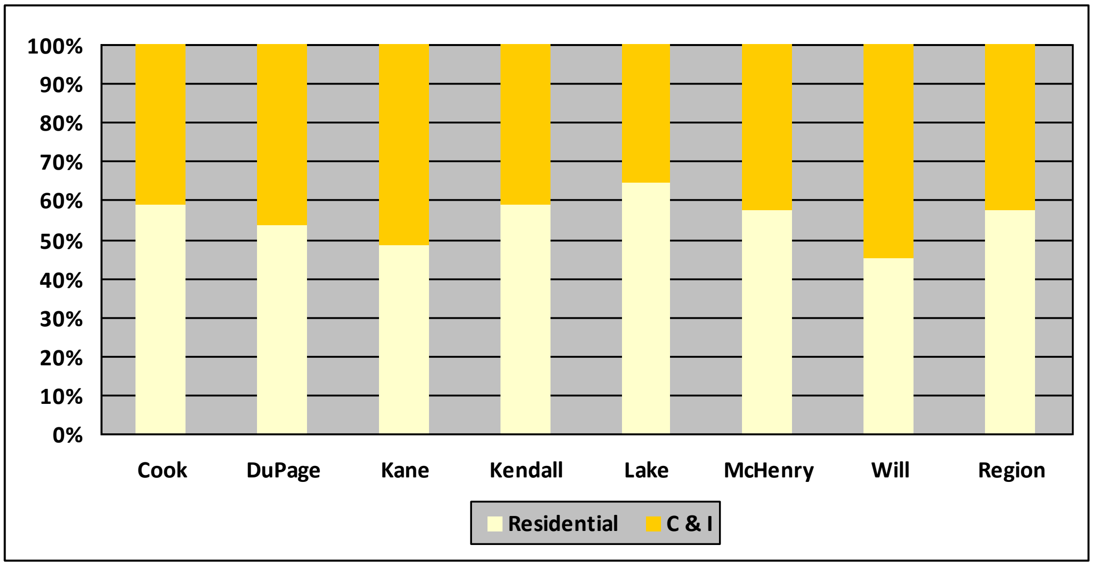
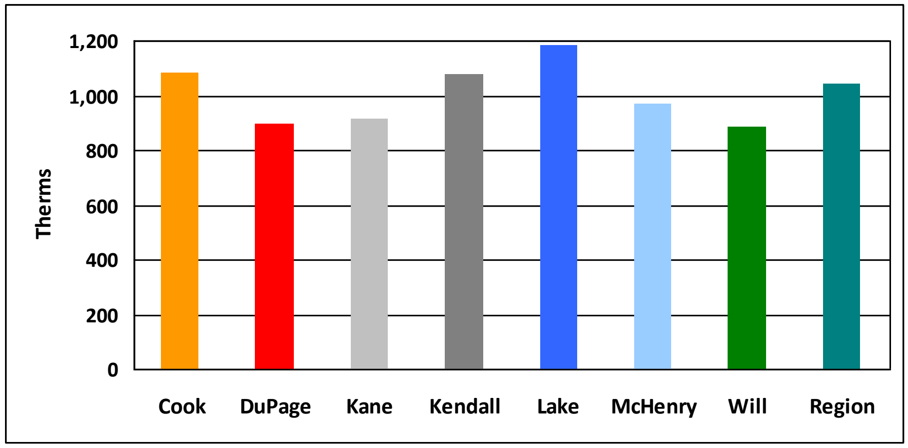


Table 7. Natural Gas Consumption by Sector as %

	Residential (%)	C & I (%)
Cook	59	41
DuPage	54	46
Kane	48	52
Kendall	59	41
Lake	64	36
McHenry	58	42
Will	45	55
Region	57	43

Figure 9. Region and County Residential Natural Gas Consumption per HH



Electricity

Total Consumption, county breakdown + by sector

In 2005, the amount of electricity consumed in CMAP region was 85 billion kilowatt hours (85,498,236,248 kWh). Again, consumption amounts are closely related to each county’s rank in population size. (Figure 10 and Table 8.)

Figure 10. County Electricity Consumption as % of Region

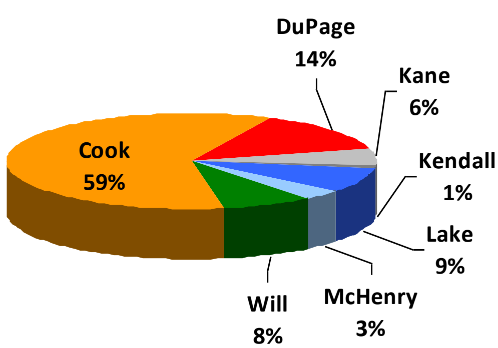


Table 8. Electricity Consumption and Population

Rank	Rank by Population Size	Rank by Electricity Consumption (kWh)
1	Cook	51,000,097,200
2	DuPage	11,642,109,688
3	Lake	7,573,847,852
4	Will	6,837,876,039
5	Kane	4,936,700,065
6	McHenry	2,783,917,642
7	Kendall	723,687,762

Sources: 2005 Consumption Data, Commonwealth Edison; and the U.S. Census Bureau, 2005 American Community Survey.

In 2005, sixty-nine (69%) percent of the region’s consumption occurred in the commercial and industrial sector, in large part due to offices and retail that use large amounts of electricity for lighting and office equipment. (Table 9 and Figure 11.) Average annual consumption per household in the CMAP region is 8,795 kilowatt hours, which amounts to approximately $756 annual electricity expenses per household.[6] (Table 10.) This number is simply an average and varies in each household depending on factors that include square footage, the presence of air conditioning, and the efficiency of lighting, appliances and systems. These influencing factors are applicable at the county level as well. Please keep these influential variables in mind while reading the report. Revisit Table 2 and Table 3 to examine housing age and type across the region. Newer homes and buildings likely use more electricity due to a common increase in size, as well as the addition of central air conditioning and other consuming electric appliances. It is important to note that electricity consumption per household is not the same as natural gas consumption, where age of housing is the main factor. For electricity consumption, the size is the major factor. Therefore, in Cook County, where homes are small in comparison, electricity consumption may be low; however, due to the age of homes, natural gas consumption is higher.

Table 9. Regional Electricity Consumption (Residential, C & I)

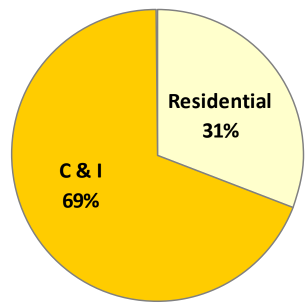
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 10. Regional Residential Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Region	8,795	$756

* 2,989,996 HH (2005 – 2007 ACS)

Figure 11. Regional Electricity Consumption by Sector



Each county varies in how its sectors consume electricity, and the consumption reports for each individual county explore them in more detail. Below, Figure 12 and Table 11 show electricity consumption by sector in the counties at a glance, and for quick comparison purposes Figure 13 provides context by displaying residential electricity consumption per household by county.

Figure 12. Region and County Electricity Consumption by Sector as % Total Consumption

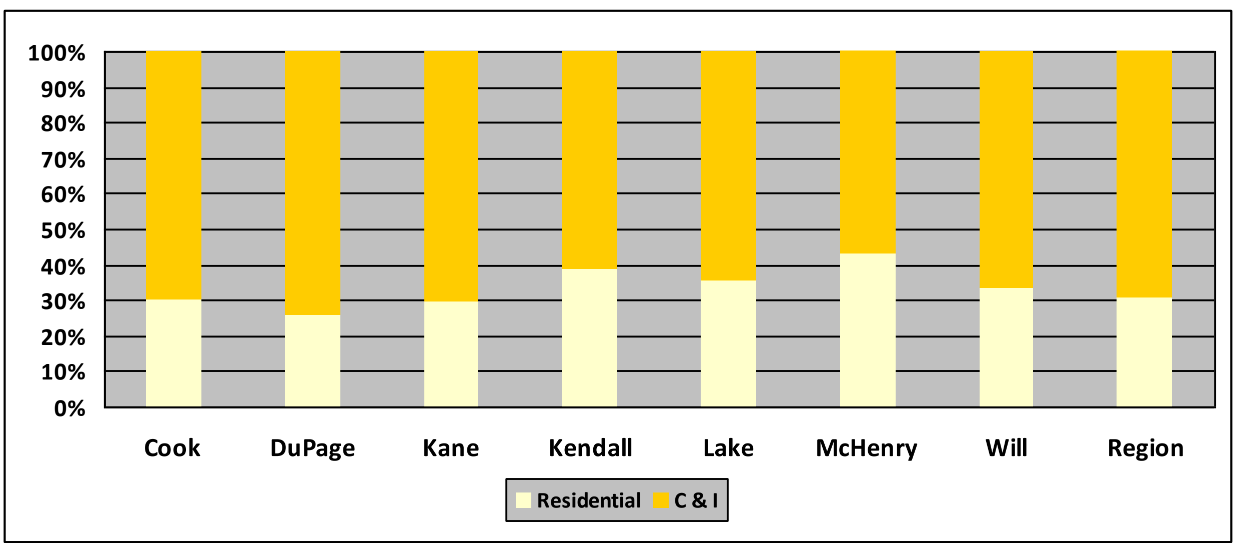
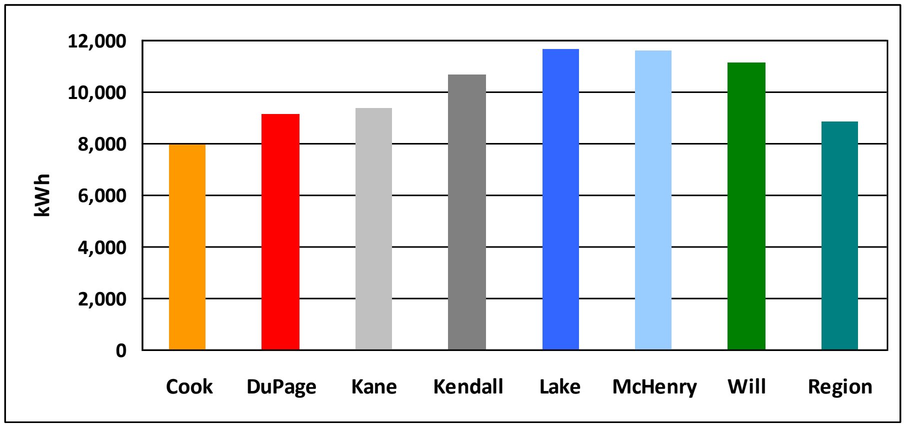


Table 11. Electricity Consumption by Sector as %

	Residential (%)	C & I (%)
Cook	30	70
DuPage	26	74
Kane	29	71
Kendall	39	61
Lake	36	64
McHenry	43	57
Will	33	67
Region	31	69

Figure 13. Region and County Residential Electricity Consumption per HH



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in the CMAP region was 55 billion miles (55,347,815,873.) We can divide total VMT by number of households and arrive at an average number of 18,511 VMT per household.
(Table 12.)

Table 12. Regional Vehicle Miles Traveled

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

It should be noted that VMT per household is simply an average and varies depending on different factors, including car ownership and public transportation ridership, and that even these variations are influenced by many different sub-factors including but not limited to income, and access, availability and convenience of public transportation. For example, households with higher incomes may own multiple cars, which increase their annual VMT from the average. Households situated close to reliable public transit or major employment centers may experience decreased annual VMT, because they do not drive their cars as much.

County Breakdown

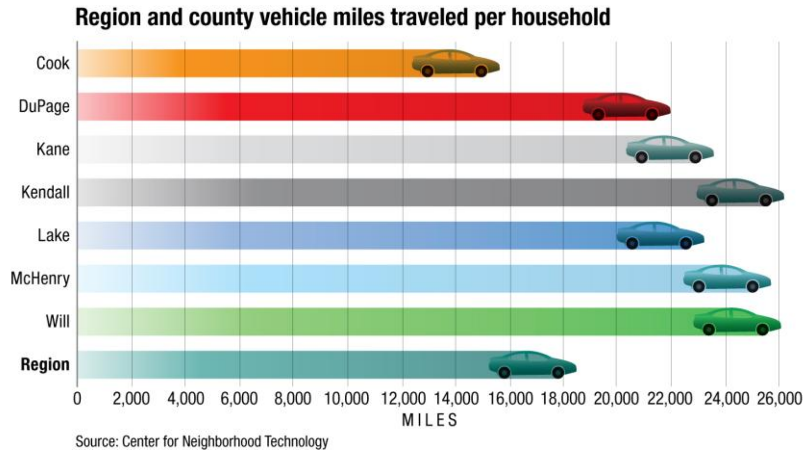
VMT amounts are again closely related to each county's rank in population size, because simply put, more people equals more cars on the road. (Table 13.) However, when we examine VMT per household we see that Cook County's is the lowest, largely due to its extensive public transportation network and concentration of employment centers in downtown Chicago and the immediate surrounding area. Generally, the farther out the county is from downtown Chicago/Cook County, the higher the annual VMT per household. (Figure 14.)

Table 13. VMT and Population

Rank	Rank by Population Size	Rank by Annual VMT	Annual VMT attributed to Households
1	Cook	34,370,678,312	30,292,202,554
2	DuPage	8,675,394,497	7,283,778,000
3	Lake	5,828,892,021	5,405,748,000
4	Will	5,300,575,756	5,336,716,500
5	Kane	3,520,486,524	3,663,012,000
6	McHenry	2,146,275,643	2,675,387,500
7	Kendall	684,711,260	690,971,319

Sources: 2005 Illinois Department of Transportation Travel Statistics and the U.S. Census Bureau, 2005 American Community Survey.

Figure 14. Region and County VMT per Household



Note: The methodology selected by CMAP to calculate household VMT uses a different approach than the methodology for total VMT (as reported by IDOT). Due to this discrepancy, the household VMT numbers are larger than the total VMT for 4 counties (Will, Kane, McHenry, and Kendall). The IDOT numbers measure VMT driven on roads in the counties, whereas the method for determining household VMT measures the miles driven by vehicles registered in that county. Therefore, if the vehicles owned by households in a certain county are driven outside of the county a significant amount, it is possible that household VMT may be larger than total VMT for a county.

Energy Consumption by County

Cook County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in Cook County was 3.5 billion therms (3,565,888,888). (Table 14.) To put this in perspective, the county's consumption accounts for about 66% of the entire seven-county region's natural gas consumption, while the county's population accounts for approximately 62% of the region's population.

Natural Gas by sector

In 2005, fifty-nine (59%) percent of Cook County's natural gas consumption occurred in the residential sector (Figure 15), which is comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 1,084 therms, nearly the identical average for the region. This amounts to approximately $1,271 annual natural gas expenses per household.[6] (Table 15.)

Table 14. Cook County Natural Gas Consumption (Residential, C & I)

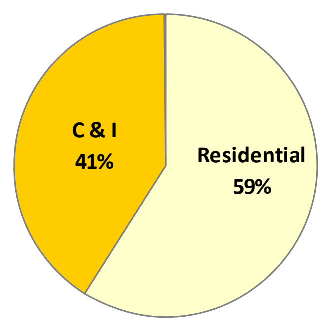
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Cook County	2,101,159,795	59	1,464,729,092	41	3,565,888,888
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 15. Cook County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Cook County*	1,084	$1,271
Region	1,044	$1,224

* 1,937,864 HH (2005 – 2007 ACS)

Figure 15. Cook County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in Cook County was 51 billion kilowatt hours (51,000,097,200). (Table 16.) To put this in perspective, the county's consumption accounts for about 59% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 62% of the region's population.

Electricity by sector

In 2005, seventy (70%) percent of Cook County's electricity consumption occurred in the commercial and industrial sector (Figure 16), which is comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 7,935 kilowatt hours, which is slightly lower than the regional average. This amounts to approximately $682 annual electricity expenses per household.[6] (Table 17.)

Table 16. Cook County Electricity Consumption (Residential, C & I)

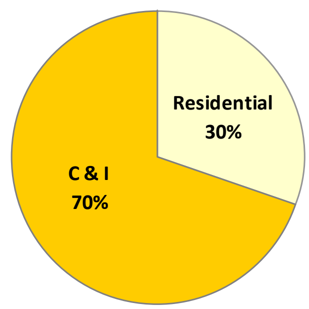
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Cook County	15,376,395,958	30	35,623,701,242	70	51,000,097,200
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 17. Cook County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Cook County*	7,935	$682
Region	8,795	$756

* 1,937,864 HH (2005 – 2007 ACS)

Figure 16. Cook County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in the Cook County was 30.3 billion miles (30,292,202,554). We can divide total VMT by number of households and arrive at an average annual number of 15,632, the lowest in the region. (Table 18.)

Table 18. Cook County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Cook County	34,370,678,312	30,292,202,554	1,937,864	15,632
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

DuPage County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in DuPage County was 551 million therms (551,843,159). (Table 19.) To put this in perspective, the county's consumption accounts for about 10% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 11% of the region's population.

Natural Gas by sector

In 2005, fifty-four (54%) percent of DuPage County's natural gas consumption occurred in the residential sector (Figure 17), which is comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 898 therms, which is lower than the regional average. This amounts to approximately $1,053 annual natural gas expenses per household.[6] (Table 20.) A lower average household consumption is likely due to a combination of factors that include newer housing stock which is generally more efficient (22% of the county's existing building stock was built within the last 20 years) and a sizeable percentage of multi-family units which generally consume less due to less square footage (almost 40%).[7]

Table 19. DuPage County Natural Gas Consumption (Residential, C & I)

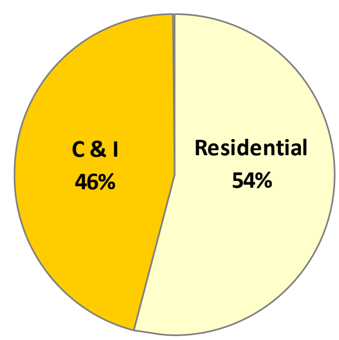
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
DuPage County	296,676,157	54	255,167,002	46	551,843,159
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 20. DuPage County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
DuPage County*	898	$1,053
Region	1,044	$1,224

*330,540 HH (2005 – 2007 ACS)

Figure 17. DuPage County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in DuPage County was 11.6 billion kilowatt hours (11,642,109,688). (Table 21.) To put this in perspective, the county's consumption accounts for about 13% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 11% of the region's population.

7 U.S. Census Bureau, 2007 American Community Survey

Electricity by sector

In 2005, seventy-four (74%) percent of DuPage County's electricity consumption occurred in the commercial and industrial sector (Figure 18), which is comparable, though slightly higher than the region's sector breakdown. At the household level, the county's average annual consumption is 9,124 kilowatt hours, which is slightly higher than the regional average. This amounts to approximately $785 annual electricity expenses per household.[6] (Table 22.)

Table 21. DuPage County Electricity Consumption (Residential, C & I)

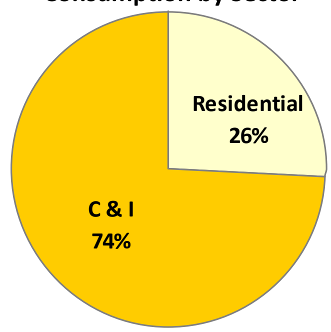
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
DuPage County	3,015,947,372	26	8,626,162,317	74	11,642,109,688
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 22. DuPage County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
DuPage County*	9,124	$785
Region	8,795	$756

* 330,540 HH (2005 – 2007 ACS)

Figure 18. DuPage County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in DuPage County was 7.3 billion miles (7,283,778,000). We can divide total VMT by number of households and arrive at an average annual number of 22,036 VMT per household. (Table 23.)

Table 23. DuPage County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
DuPage County	8,675,394,497	7,283,778,000	330,540	22,036
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

Kane County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in Kane County was 292 million therms (292,265,089). (Table 24.) To put this in perspective, the county's consumption accounts for about 5% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 5% of the region's population.

Natural Gas by sector

In 2005, fifty-two (52%) percent of Kane County's natural gas consumption occurred in the commercial and industrial sector (Figure 19), which is a reverse of the region's sector breakdown in which the residential sector has the slight edge. At the household level, the county's average annual consumption is 913 therms, which is lower than the region. This amounts to approximately $1,071 annual natural gas expenses per household.[6] (Table 25.) This low average is likely due to newer housing stock, which is generally more efficient. Over 35% of the county's existing housing stock was built within the last 20 years.[8]

Table 24. Kane County Natural Gas Consumption (Residential, C & I)

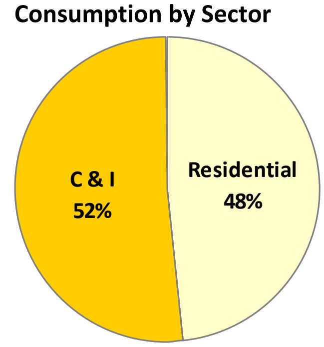
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Kane County	141,615,345	48	150,649,744	52	292,265,089
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 25. Kane County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Kane County*	913	$1,071
Region	1,044	$1,224

*155,090 HH (2005 – 2007 ACS)

Figure 19. Kane County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in Kane County was 4.9 billion kilowatt hours (4,936,700,065). (Table 26.) To put this in perspective, the county's consumption accounts for about 6% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 6% of the region's population.

Electricity by sector

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8 U.S. Census Bureau, 2007 American Community Survey.

In 2005, seventy-one (71%) percent of Kane County's electricity consumption occurred in the commercial and industrial sector (Figure 20), which is the comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 9,376 kilowatt hours, which is higher than the regional average. This amounts to approximately $806 annual electricity expenses per household.[6] (Table 27.)

Table 26. Kane County Electricity Consumption (Residential, C & I)

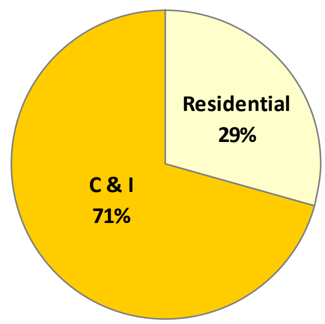
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Kane County	1,454,100,543	29	3,482,599,522	71	4,936,700,065
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 27. Kane County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Kane County*	9,376	$806
Region	8,795	$756

*155,090 HH (2005 – 2007 ACS

Figure 20. Kane County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in Kane County was 3.7 billion miles (3,663,012,000). We can divide total VMT by number of households and arrive at an average annual number of 23,619 VMT per household, which is higher than the regional average. (Table 28.)

Table 28. Kane County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Kane County	3,520,486,524	3,663,012,000	155,090	23,619
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

Kendall County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in Kendall County was 39.5 million therms (39,530,636). (Table 29.) To put this in perspective, the county's consumption accounts for about 0.9% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 1.0% of the region's population.

Natural Gas by sector

In 2005, fifty-nine (59%) percent of Kendall County's natural gas consumption occurred in the residential sector (Figure 21), comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 1,079 therms, nearly the identical average for the region. This amounts to approximately $1,265 annual natural gas expenses per household.[6] (Table 30.)

Table 29. Kendall County Natural Gas Consumption (Residential, C & I)

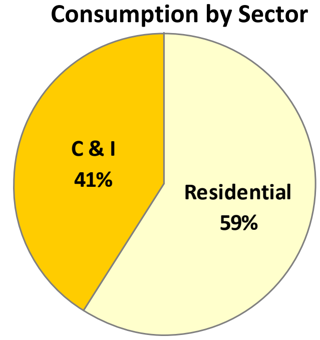
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Kendall County	28,404,347	59	19,875,970	41	48,280,317
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 30. Kendall County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Kendall County*	1,079	$1,265
Region	1,044	$1,224

* 26,333 HH (2005 – 2007 ACS)

Figure 21. Kendall County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in Kendall County was 723 million kilowatt hours (723,687,762). (Table 31.) To put this in perspective, the county's consumption accounts for 0.8% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 1.0% of the region's population.

Electricity by sector

In 2005, sixty-one (61%) percent of Kendall County's electricity consumption occurred in the commercial and industrial sector (Figure 22), similar to the region's sector breakdown which is more heavily influenced by the commercial and industrial sector. At the household level, the county's average annual consumption is 10,668 kilowatt hours, higher than the regional average. This amounts to approximately $917 annual electricity expenses per household.[6] (Table 32.) Kendall County's high residential average is probably a result of larger square footage and the predominance of single family homes.

Table 31. Kendall County Electricity Consumption (Residential, C & I)

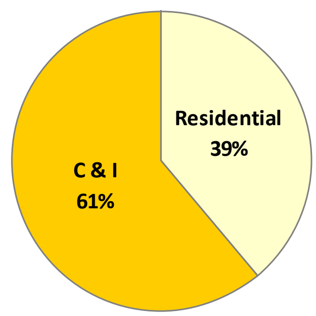
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Kendall County	280,921,972	39	442,765,790	61	723,687,762
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 32. Kendall County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Kendall County*	10,668	$917
Region	8,795	$756

* 26,333 HH (2005 – 2007 ACS)

Figure 22. Kendall County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in Kendall County was 691 million miles (690,971,319). We can divide total VMT by number of households and arrive at an average annual number of 26,240 VMT per household, second highest in the region. (Table 33.)

Table 33. Kendall County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Kendall County	684,711,260	690,971,319	26,333	26,240
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

Lake County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in Lake County was 422 million therms (425,822,712). (Table 34.) To put this in perspective, the county's consumption accounts for about 8% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 8% of the region's population.

Natural Gas by sector

In 2005, sixty-four (64%) percent of Lake County's natural gas consumption occurred in the residential sector (Figure 23), which is higher than the region's sector breakdown which favors residential as well. At the household level, the county's average annual consumption is 1,180 therms, and is slightly higher than the average for the region. This amounts to approximately $1,384 annual natural gas expenses per household.[6] (Table 35.)

Table 34. Lake County Natural Gas Consumption (Residential, C & I)

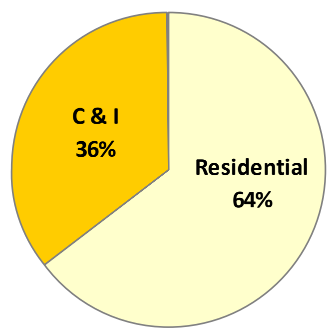
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Lake County	273,917,101	64	151,905,611	36	425,822,712
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 35. Lake County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Lake County*	1,180	$1,384
Region	1,044	$1,224

* 232,046 HH (2005 – 2007 ACS)

Figure 23. Lake County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in Lake County was 7.5 billion kilowatt hours (7,573,847,852). (Table 36.) To put this in perspective, the county's consumption accounts for about 9% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 8% of the region's population.

Electricity by sector

In 2005, sixty-four (64%) percent of Lake County's electricity consumption occurred in the commercial and industrial sector (Figure 24.), which is comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 11,631 kilowatt hours, which is much higher than the regional average. This amounts to approximately $1,000 annual electricity expenses per household.[6] (Table 37.) Lake County's high average is probably a result of larger square footage and the predominance of single family homes.

Table 36. Lake County Electricity Consumption (Residential, C & I)

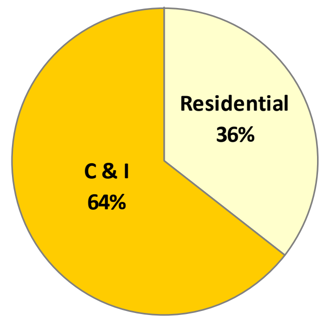
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Lake County	2,699,023,830	36	4,874,824,022	64	7,573,847,852
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 37. Lake County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Lake County*	11,631	$1,000
Region	8,795	$756

* 232,046 HH (2005 – 2007 ACS)

Figure 24. Lake County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in Lake County was 5.4 billion miles (5,405,748,000). We can divide total VMT by number of households and arrive at an average annual number of 23,296 VMT per household, which is higher than the regional average. (Table 38.)

Table 38. Lake County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Lake County	5,828,892,021	5,405,748,000	232,046	23,296
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

McHenry County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in McHenry County was 174 million therms (174,814,538). (Table 39.) To put this in perspective, the county's consumption accounts for about 3% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 4% of the region's population.

Natural Gas by sector

In 2005, fifty-eight percent (58%) of McHenry County's natural gas consumption occurred in the residential sector (Figure 25), which is comparable to the region's sector breakdown. At the household level, the county's average annual consumption is 971 therms, slightly lower than the average for the region. This amounts to approximately $1,139 annual natural gas expenses per household[6] (Table 40).

Table 39. McHenry County Natural Gas Consumption (Residential, C & I)

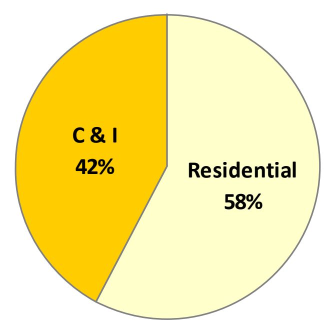
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
McHenry County	100,616,102	58	74,198,436	42	174,814,538
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 40. McHenry County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
McHenry County*	971	$1,139
Region	1,044	$1,224

*103,623 HH (2005 – 2007 ACS)

Figure 25. McHenry County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in McHenry County was 2.7 billion kilowatt hours (2,783,917,642). (Table 41.) To put this in perspective, the county's consumption accounts for about 3% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 4% of the region's population.

Electricity by sector

In 2005, fifty-seven (57%) percent of Lake County's electricity consumption occurred in the commercial and industrial sector (Figure 26), which is lower than the region's sector breakdown. At the household level, the county's average annual consumption is 11,560 kilowatt hours, which is significantly higher than the regional average. This amounts to approximately $994 annual electricity expenses per household[6] (Table 42). McHenry County's high average is probably a result of larger square footage and the predominance of single family homes.

Table 41. McHenry County Electricity Consumption (Residential, C & I)

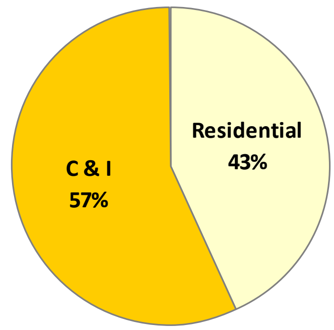
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
McHenry County	1,197,956,940	43	1,585,960,702	57	2,783,917,642
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 42. McHenry County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
McHenry County*	11,560	$994
Region	8,795	$756

*103,623 HH (2005 – 2007 ACS)

Figure 26. McHenry County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in McHenry County was 2.7 billion miles (2,675,387,500). We can divide total VMT by number of households and arrive at an average annual number of 25,818 VMT per household, which is higher than the regional average. (Table 43.)

Table 43. McHenry County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
McHenry County	2,146,275,643	2,675,387,500	103,623	25,818
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

Will County

Natural Gas

Total Consumption

In 2005, the amount of natural gas consumed in Will County was 401 million therms (401,485,665). (Table 44.) To put this in perspective, the county's consumption accounts for about 7% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 8% of the region's population.

Natural Gas by sector

In 2005, fifty-five (55%) percent of Will County's natural gas consumption occurred in the commercial and industrial sector (Figure 27), which is a reverse of the region's sector breakdown in which the residential sector has the slight edge instead. At the household level, the county's average annual consumption is 882 therms, and is the lowest county average in the region. This amounts to approximately $1,035 annual natural gas expenses per household.[6] (Table 45.) This is likely due to newer housing stock, which is generally more efficient. An overwhelming 49.8% of the county's existing housing stock was built within the last 20 years.[9]

Table 44. Will County Natural Gas Consumption (Residential, C & I)

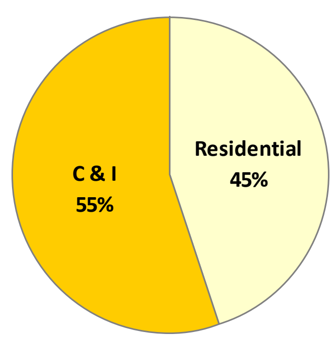
	Residential		Commercial & Industrial		Total
	Therms	% of total	Therms	% of total	Therms
Will County	180,399,933	45	221,085,733	55	401,485,665
Region	3,122,788,779	57	2,337,611,588	43	5,460,400,368

Table 45. Will County Residential Natural Gas Consumption and Costs

Average annual residential natural gas consumption		
	Therms per HH	Annual $ per HH
Will County*	882	$1,035
Region	1,044	$1,224

* 204,500 HH (2005 – 2007 ACS)

Figure 27. Will County Natural Gas Consumption by Sector



Electricity

Total Consumption

In 2005, the amount of electricity consumed in Will County was 6.8 billion kilowatt hours (6,837,876,039). (Table 46.) To put this in perspective, the county's consumption accounts for about 8% of the entire seven-county region's electricity consumption, while the county's population accounts for approximately 8% of the region's population.

9 U.S. Census Bureau, 2007 American Community Survey.

Electricity by sector

In 2005, sixty-seven (67%) percent of Will County's electricity consumption occurred in the commercial and industrial sector (Figure 28), which is slightly lower than the region's sector breakdown. At the household level, the county's average consumption is 11,109 kilowatt hours, significantly higher than the regional average. This amounts to approximately $955 annual electricity expenses per household.[6] (Table 47.) This high average is likely due to Will County's newer housing stock, which commonly increase in size, as well as the addition of central air conditioning and other consuming electric appliances

Table 46. Will County Electricity Consumption (Residential, C & I)

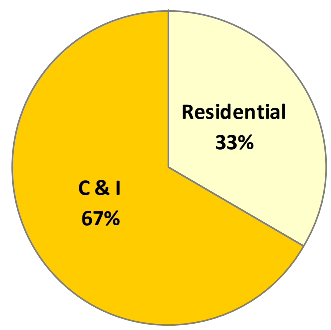
	Residential		Commercial & Industrial		Total
	kWh	% of total	kWh	% of total	kWh
Will County	2,271,873,428	33	4,566,002,611	67	6,837,876,039
Region	26,296,220,042	31	59,202,016,205	69	85,498,236,248

Table 47. Will County Electricity Consumption and Costs

Average annual residential electricity consumption		
	kWh per HH	Annual $ per HH
Will County*	11,109	$955
Region	8,795	$756

* 204,500 HH (2005 – 2007 ACS)

Figure 28. Will County Electricity Consumption by Sector



Transportation - Vehicle Miles Traveled

Vehicle Miles Traveled (VMT) for all on-road travel was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT). Additionally, auto travel due solely to households was estimated using odometer readings taken during emissions testing and provided by the Illinois Department of Motor Vehicles. In 2005, the number of VMT attributed to households in Will County was 5.3 billion miles (5,336,716,500). We can divide total VMT by number of households and arrive at an average annual number of 26,096 VMT per household, which is the highest in the region. (Table 48.)

Table 48. Will County VMT: Total and Household Data

	Total On-Road VMT	Total HH VMT	Number of HH	VMT per HH
Will County	5,300,575,756	5,336,716,500	204,500	26,096
Region	60,527,014,013	55,347,815,873	2,989,996	18,511

Energy Consumption Summary for Selected Municipalities

Community-wide natural gas consumption, electricity consumption, and vehicle miles traveled for a selected group of geographically diverse municipalities in the region were conducted for the year 2005. Information was presented for Algonquin, Aurora, Blue Island, Highland Park, Joliet, and Schaumburg. Please see Appendix A for detailed municipal reports.

Natural Gas Consumption

Figure 29. Natural Gas Consumption by Sector as % of Total Consumption for Selected Municipalities

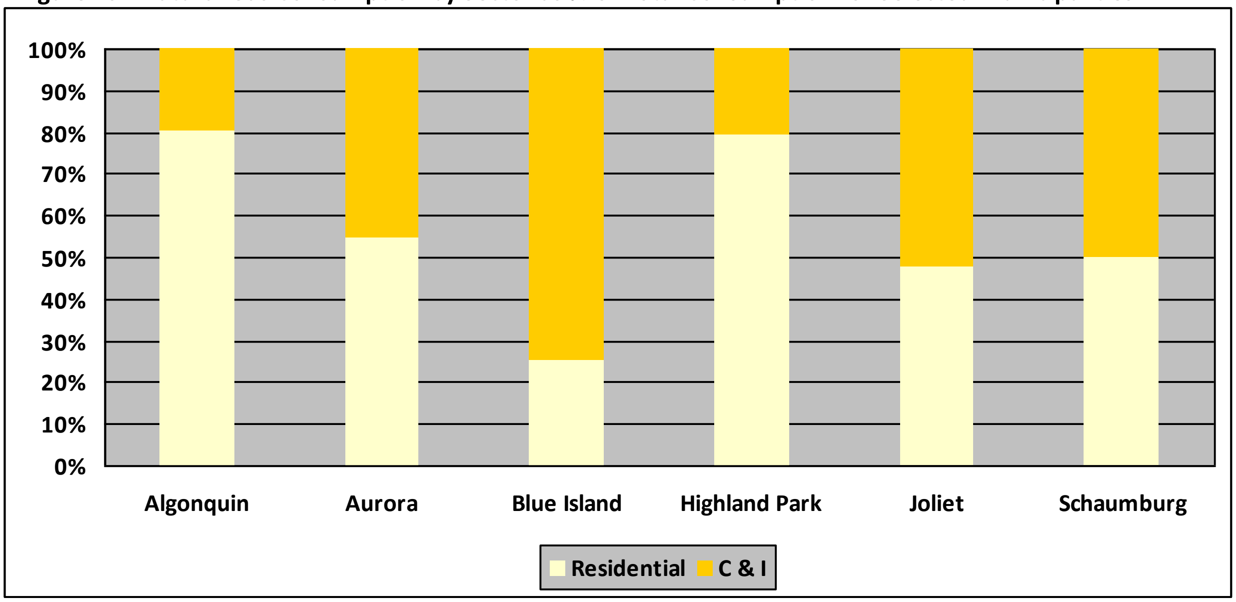
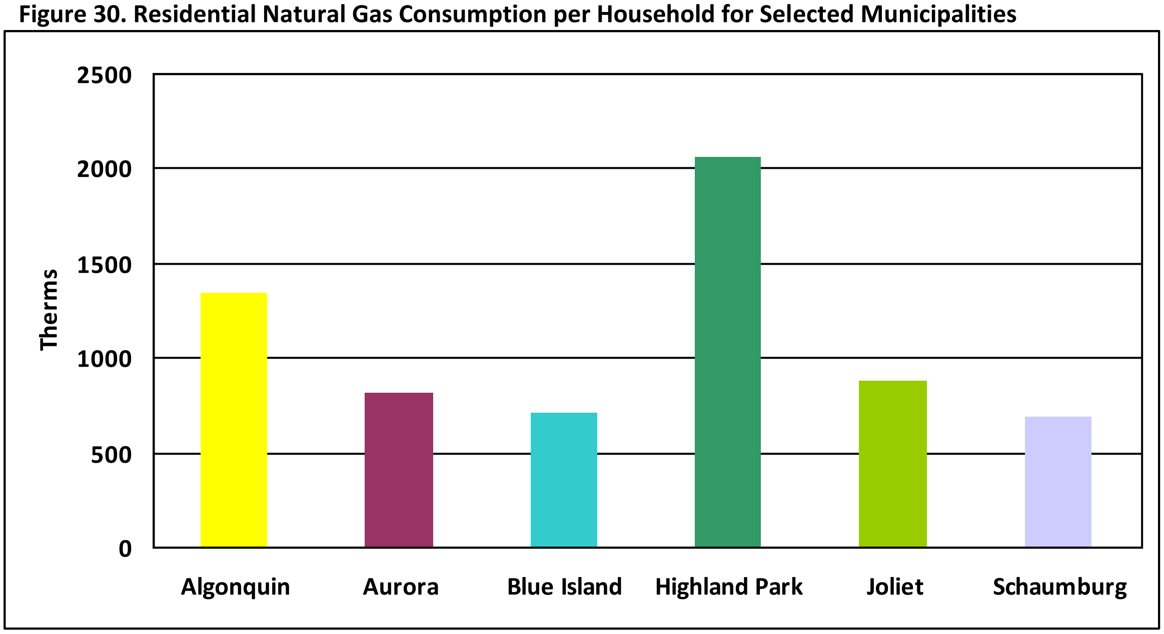


Figure 30. Residential Natural Gas Consumption per Household for Selected Municipalities



Electricity Consumption

Figure 31. Electricity Consumption by Sector as % of Total Consumption for Selected Municipalities

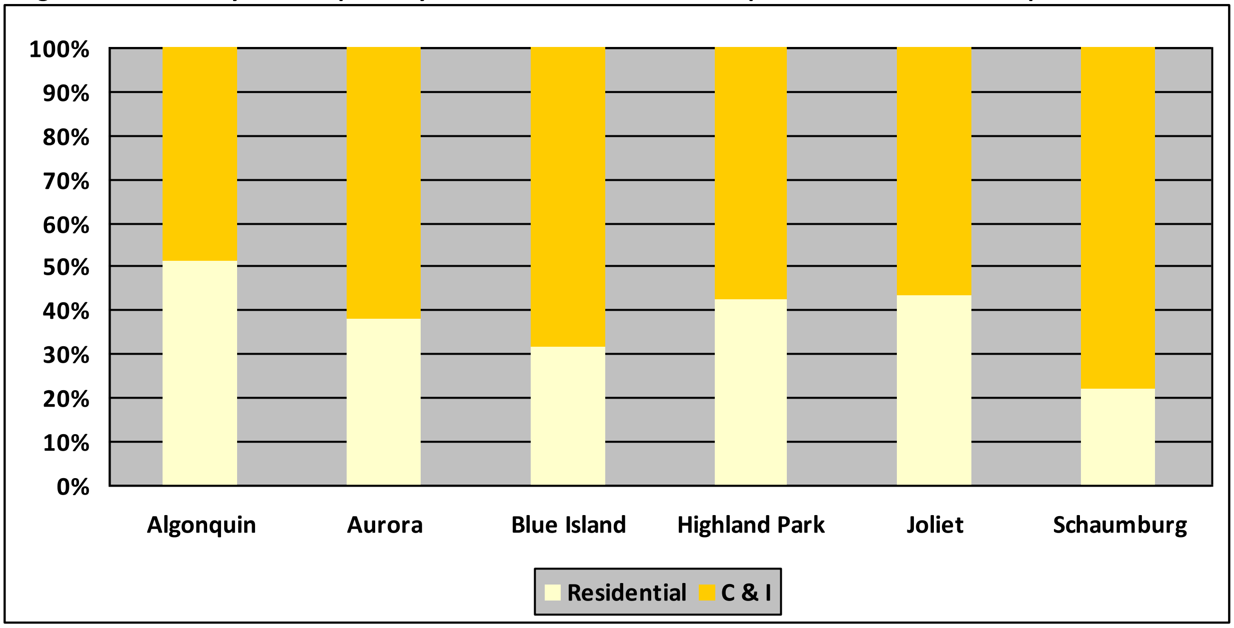
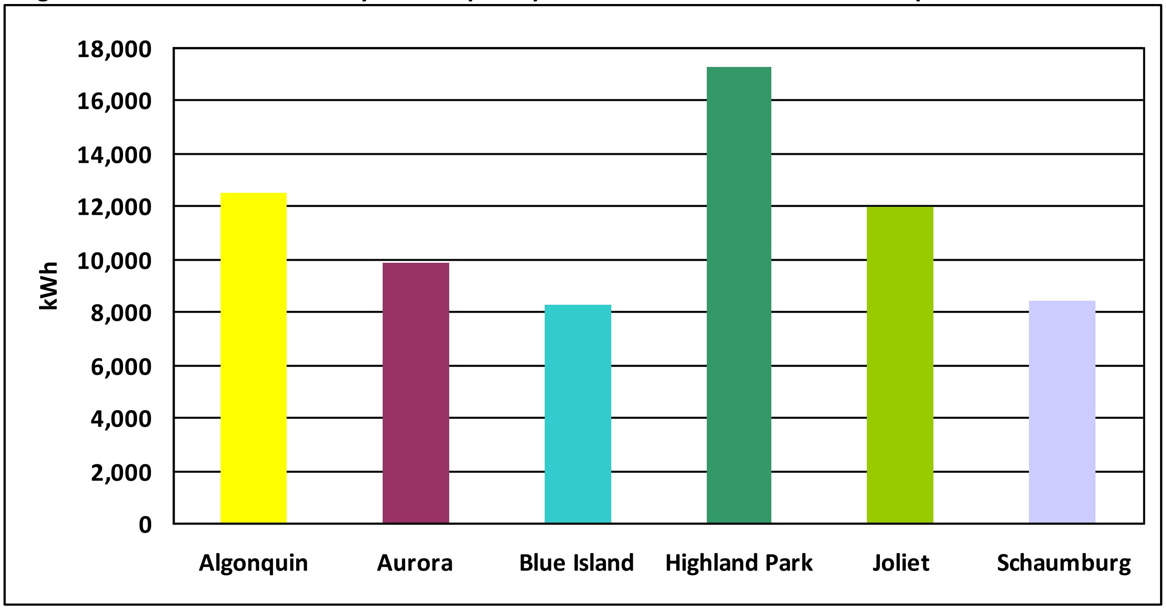
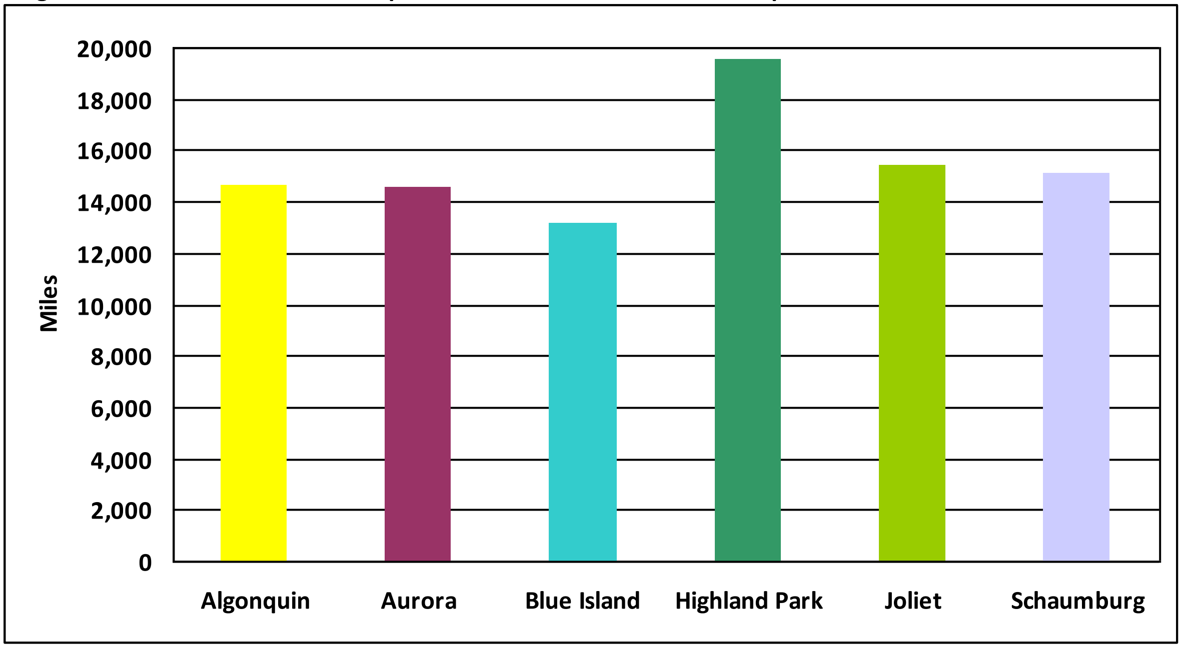


Figure 32. Residential Electricity Consumption per Household for Selected Municipalities



Transportation – Vehicle Miles Traveled

Figure 33. Vehicle Miles Traveled per Household for Selected Municipalities



Regional Energy Strategies Analysis

Introduction

The Regional Energy Strategies Analysis first outlines the types of energy strategies to be analyzed for consumption and cost savings, and then discusses the *GO TO 2040* Regional Scenarios and where each of the strategies fit within. Finally, the Analysis provides a descriptive summary of strategies, with energy and cost savings per unit, followed by the potential regional savings that can be achieved with varying levels of implementation.

Developing Strategies for Reducing Consumption

The regional energy profile depicts energy consumption for the region and individual counties. Assuming that the region will continue to grow as anticipated, energy consumption is expected to rise considerably with that growth. After having established the connection between energy consumption and greenhouse gas emissions, reducing the region's energy consumption becomes the main element of any regional response to climate change. And while emissions reductions from any source will help address global warming, the Chicago Greenhouse Gas Baseline Inventory and Forecast cites that electricity, natural gas and transportation were the main sources of the region's emissions in 2005, at an overwhelming 87%. Thus, when considering strategies to reduce our carbon footprint, it makes sense to focus on buildings, transportation and the people living, working and traveling in our region.

Energy Strategy Areas

Energy in Buildings

The aforementioned report[10] cites that 63% of all emissions in the seven-county region in 2005 came from the consumption of electricity and natural gas, or in a nutshell, energy use in buildings. Targeting strategies that focus on energy in buildings will result in energy consumption reductions among both households and businesses across the region.

Behavior Change

Some strategies can achieve significant savings on their own technological merit, while others require making changes in the way we go about our everyday lives, both at home and in the workplace. Collectively, these small changes in behavior have the potential for big reductions in energy use. Acknowledging personal behavior as a tool for energy efficiency may also enhance energy savings in other strategy areas, such as the homeowner who decides to save energy by only washing full loads of laundry or dishes.

Transportation

The second highest emitter of greenhouse gas emissions in the region is transportation[11]. Reducing vehicle miles traveled by increasing other travel options, improved systems operations,

10 The Chicago Region Greenhouse Gas Baseline Inventory and Forecast, July 2009. Chicago Metropolitan Agency for Planning

11 The Chicago Region Greenhouse Gas Baseline Inventory and Forecast, July 2009. Chicago Metropolitan Agency for Planning

encouraging transit-oriented design and other ideas are a mix of applicable strategies designed to reduce the number of vehicle miles traveled (VMT) in the region. CMAP conducted an earlier analysis of transportation strategies, so instead of re-stating them in this report, the overall number of VMT reduced for each Regional Scenario is supplied instead.

2040 Regional Scenarios

The strategies within the subject areas are further characterized by where they fit in with CMAP's *GO TO 2040* planning process. *GO TO 2040* is employing scenario evaluation as a useful tool to examine a host of different options and strategies for growth in the region. During the period in which this report was prepared, three alternative scenarios were under consideration, in juxtaposition to the Reference (business as usual) Scenario. In January 2010, CMAP will issue a "preferred Regional Scenario" combining strategies drawn from each of the earlier alternative scenarios to arrive at a set of strategies that the region is capable of implementing while achieving maximum results. Similarly, some strategies are not cumulative as implementation of one may directly affect potential results of another. For example, if "Green Building for New Construction" is implemented region-wide, the energy savings garnered by potential "Energy Code Updates" for new construction will be drastically reduced.

Reinvest

This scenario aims to reinvest in existing communities by working within existing communities to support the region's growth and development instead of building in areas that have never had development before. This scenario would keep existing infrastructure and communities strong—but it will also be quite costly, and could change the character of the region's communities and neighborhoods as they accommodate new growth.

The energy strategies that fall into the Reinvest scenario include the following:

- Green Building Renovation, Residential
- Green Building Renovation, Commercial
- Appliance Trade-in, Refrigerator
- Appliance Trade-in, Window Air Conditioner
- Capital Improvements to Transit Facilities
- Transit System Operations: Wait Time Reductions
- Freight Operations Improvements
- HOV/Truck-only Lanes
- Arterial Improvements (in redeveloping and congested areas)
- Pedestrian Improvements (in redeveloping areas)
- Transit-Oriented Development

Preserve

This scenario targets preservation of the best features of the region's communities by accommodating growth without dramatically changing their character. This scenario would preserve the region's assets—but it might be difficult to accommodate anticipated growth between now and 2040.

The energy strategies that fall into the Preserve scenario include the following:

- Residential Retrofits
- Commercial/Industrial Retrofits

- Updating Energy Code
- Transportation Demand Management
- Parking Policy
- Car-sharing
- Pedestrian/Bicycle Improvements
- Transit System Operations: Service Extensions
- Transit System Operations: Wait Time Reductions
- Transit System Operations: Expanded Paratransit
- Highway System Operations: Access Management/Increased Intersection Efficiency

Innovate

This scenario relies on innovation and technological improvements, allowing the region to continue its outward growth patterns, but doing so more efficiently and with less impact. While this scenario allows continued growth, it relies on the adoption of advanced technologies that may or may not occur.

The energy strategies that fall into the Innovate scenario include the following:

- Green Building New Construction, Residential
- Green Building New Construction, Commercial
- Household Renewable Energy
- Behavior Change, Residential
- Behavior Change, Commercial
- Variable Pricing on Expressways
- Variable Pricing for Parking
- Advanced Arterial Signal Systems
- Transit Signal Priority
- Arterial Rapid Transit
- Transit Traveler Information Services
- Roundabouts/Other Innovative Intersection Treatments
- Context Sensitive Solutions
- Advanced Vehicle Technology
- Alternative Fuels
- Pedestrian Improvements (as part of new development)

Energy Strategy Summaries

The strategy matrices below organize strategies as to where they fall within the three *GO TO 2040* planning scenarios, and then by type of energy strategy--energy in buildings and energy behavior, and transportation. A summary is provided for each strategy, as well as estimated energy savings. When possible, per unit savings are calculated, and savings at a larger scale (as indicated in the following strategy descriptions) are also provided. A total estimated savings per *GO TO 2040* planning scenario is provided as well.

It should be noted that the strategies may or may not be applicable to every municipality. Each municipality will likely need to determine which strategies are a good fit for their respective community, and may also wish to consider the financial, legal and political feasibility of taking action.

Following the strategy matrices, a full description of each strategy is provided, less the transportation ones which are fully described in other CMAP reports. In Table 49 below, the regional energy savings (KBTU) references the scale of implementation highlighted in the tables and text in the correlating strategy sections that follow.

Table 49. Energy Strategy Matrix

Scenario	Energy Strategy	Strategy Type	Description	Energy Savings, total KBTU (Per Unit)	Energy Savings, scaled, KBTU (Region)
Reinvest	Green Building Renovation, Residential	Energy in Buildings	Require or incentivize all residential renovations to be green.	36,956	8,321,503,837
	Green Building Renovation, Commercial	Energy in Buildings	Require or incentivize all commercial renovations to be green.	434,614	34,716,045,040
	Appliance Trade-in, Refrigerator	Behavior Change	Replace old inefficient refrigerators with energy efficiency appliances.	1,707	1,403,494,201
	Appliance Trade-in, Window Air Conditioner	Behavior Change	Replace old inefficient window air conditioning units with energy efficiency appliances.	754	132,535,797
					44,573,578,875
Preserve	Residential Retrofits	Energy in Buildings	Reduce GHG emissions by energy retrofits in existing residential buildings through a mix of energy conservation measures and technology.	36,956	37,974,812,871
	Commercial/Industrial Retrofits	Energy in Buildings	Implement energy efficiency programs to retrofit commercial and industrial buildings using existing technologies.	434,614	46,312,511,567
	Updating Energy Code	Energy in Buildings	Develop and add energy codes to general building code standards in order to increase energy efficiency of buildings.	20,202 *Lower savings range*	5,820,006,677 *Lower savings range*
					90,107,331,115
Innovate	Green Building New Construction, Residential	Energy in Buildings	Require new residential construction to be built to green building standards to reduce energy consumption and emissions.	67,207	19,400,022,357
	Green Building New Construction, Commercial	Energy in Buildings	Require new commercial construction to be built to green building standards to reduce energy consumption and emissions.	724,456	43,451,068,082
	Behavior Change, Residential	Behavior Change	Transform concern about environment into simple personal behavioral change around the house.	12,560	25,824,929,152
	Behavior Change, Commercial	Behavior Change	Transform concern about into simple personal behavioral change in the workplace.	129,507	18,867,656,000
	Household Renewable Energy	Energy in Buildings	Increase the use of household-scale renewable power in the form of distributed generation to increase use of locally generated clean power, reducing reliance on central station power plants.	56,117	11,531,871,641
					119,075,547,232

Table 50. Transportation Energy Strategy Matrix

Scenario	Transportation Strategy	Description
Reinvest	Capital Improvements to Transit Facilities	Make systematic capital improvements in order to increase transit speed, which thus will improve schedule adherence and generate additional ridership.
	Transit System Operations: Wait Time Reductions	Reduce transit wait times by numerous potential service enhancements (supported by previous capital improvements strategy).
	Freight Operations Improvements	Facilitate easier truck access and movement to freight and related industries through various potential actions, including infrastructure, operational, and policy changes.
	HOV/Truck-only Lanes	Add capacity to expressways through addition of a managed lane; restricted to HOVs or trucks.
	Arterial Improvements (in redeveloping and congested areas)	Improve roadway infrastructure to support transit and freight; and also address congestion in higher-density areas.
	Pedestrian Improvements (in redeveloping areas)	Improve pedestrian and bicycle systems primarily through sidewalk construction and intersection improvements, reflected through Pedestrian Environment Factor (PEF) increases.
	Transit-Oriented Development (TOD)	Adopt and promote TOD concepts in order to increase density and good transit access in order to attract new growth.
		3% increase over 2040 Reference Scenario
Preserve	Transportation Demand Management	Reduce single occupancy vehicle use demand which involves a variety of elements, such as better travel information
	Parking Policy	Implement new parking policies to reduce vehicle trip and encourage use of alternative transportation
	Car-sharing	Employ programs to allow groups to share the cost of car ownership, e.g.: I-Go and Zipcar.
	Pedestrian/Bicycle Improvements	Improve pedestrian and bicycle systems through numerous improvements and changes, including areas of education, design, and policy, which is reflected through an increase in Pedestrian Environment Factor (PEF).
	Transit System Operations: Service Extensions	Improve transit system operations by through low-capital transit service extensions, including bus extensions planned by Pace and CTA.
	Transit System Operations: Wait Time Reductions	Make transit more attractive by reducing waiting times through operational improvements.
	Transit System Operations: Expanded Paratransit	Expand paratransit service offered beyond the requirement of ADA, given that ADA requirement are met.
	Highway System Operations: Access Management/Increased Intersection Efficiency	Improve roadway operations through two low-capital strategies: reduce access points through access management and frequent optimization of signal time through increased intersection efficiency.
		3% decrease over 2040 Reference Scenario
Innovate	Variable Pricing on Expressways	Reduce congestion by setting aside a number of lanes and tolls are charged at the level required to achieve predefined performance objective.
	Variable Pricing on Parking	Implement variable pricing systems to encourage and discourage travel behaviors, reducing street and parking lot congestion, increasing parking turnover, and maximizing revenue.
	Advanced Arterial Signal Systems	Improve arterial operations through technical improvements to increase road capacity without adding lanes.
	Transit Signal Priority (TSP)	Implement technical improvement (TSP) at intersections to allow transit vehicles to pass through without delay to obtain faster service and improve schedule adherence.
	Arterial Rapid Transit	Improve bus routes and enhance bus travel through implementation of a package of improvements.
	Transit Traveler Information Services	Increase and improve methods to provide travel information to passengers to increase convenience and comfort.
	Roundabouts/Other Innovative Intersection Treatments	Reduce congestion at intersections by installing roudabouts, a circular intersection form that eliminates stop signs and traffic signals, converting all movement in one direction.
	Context Sensitive Solutions	Consider surroundings when making planning or infrastructure decisions to balance the project purpose and community values.
	Advanced Vehicle Technology	Utilize advanced vehicle technology to avoid human shortcomings in physical capabilities and behaviors.
	Alternative Fuels	Maintain personal mobility and reduce fossil fuel use through providing alternative fuels options.
	Pedestrian Improvements (as part of new development)	Utilize growth and land use change to Improve pedestrian and bicycle systems through design, reflected through an increase in Pedestrian Environment Factor (PEF).
		1% increase over 2040 Reference Scenario

Strategies – Reinvest Scenario

Green Building Renovation

Table 51. Green Building Renovation Energy Savings per Household

2040 Planning Scenario: Reinvest Energy Strategy Type: Energy in Buildings		
Energy Consumption, Residential	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	287	$336
Electricity (kWh)	2,419	$208
Emissions (MT CO2e)	3.14	n/a

Table 52. Green Building Renovation Energy Savings per Commercial

2040 Planning Scenario: Reinvest Energy Strategy Type: Energy in Buildings		
Energy Consumption, Commercial	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	2,331	$2,563
Electricity (kWh)	59,043	$3,832
Emissions (MT CO2e)	51.77	n/a

While much of the focus of green buildings in the media is on new construction projects, existing buildings can also be renovated to green standards. Municipalities in the CMAP Region could require, or at the very least encourage, that all commercial and residential renovations be rated "green." Green building is defined as a way to "significantly reduce or eliminate the negative impact of buildings on the environment and on the building occupants through sustainable site planning, safeguarding water and water efficiency, energy efficiency, conservation of materials and resources, and indoor environmental quality."[12] The U.S. Green Building Council (USGBC) developed a rating system, or standard, for green buildings and is considered the country's leading authority on the topic.

A scan of green building remodeling programs show that such renovations typically involve upgrading building systems by insulating walls and the roof, sealing air leaks, replacing windows, upgrading HVAC hot water systems, replacing appliances with high efficiency models, re-commissioning building systems to assure they are properly operated, and upgrading lighting systems.

Based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas by 287 therms and the consumption of electricity by 2,419 kWh per average housing unit, for an average annual cost savings of $544. Emissions reductions per unit are estimated at 3.14 MT CO2e. For commercial accounts, the estimated energy savings per account are 2,331 therms and 59,043 kWh which amount to an estimated annual cost savings of $6,396 per account. Emissions reductions are estimated at 51.77 MT CO2e per account.

When scaled to the region, green building renovations implemented in 25% of the projected number of housing units that will be substantially renovated through 2040 would result in a reduction of 64 million therms and 544 million kWh, with a cumulative savings of $122 million, and a total emissions reduction of 0.704 MMT CO2e. For commercial green building renovations in half of all the existing commercial accounts with potential to be renovated through 2040, there is an estimated reduction of 186 million therms and 4.7 billion kWh, with a cumulative savings of $510 million in the region. Total emissions reductions are estimated 4.131

12 U.S. Green Building Council, Atlanta Chapter web site, U. S. Green Building Council, http://www.southface.org/web/resources&services/USGBC-atlanta/USGBC-atlanta.htm.

MMT CO2e. Tables 53 and 54 below show total savings if this strategy were implemented at different scales in the region.

Table 53. Residential Green Building Renovation Savings, % of Existing Housing Stock in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	25,855,221	$30,328,950	217,720,321	$18,723,948	$49,052,897	0.288
25%	**64,638,052**	**$75,822,374**	**544,300,802**	**$46,809,869**	**$122,632,243**	**0.704**
50%	129,276,104	$151,644,748	1,088,601,605	$93,619,738	$245,264,486	1.418
75%	193,914,156	$227,467,122	1,632,902,407	$140,429,607	$367,896,729	2.122

Table 54. Commercial Green Building Renovation Savings, % of Accounts/Buildings Renovated in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	37,241,553	$40,962,603	943,174,242	$61,212,008	$102,174,611	0.828
25%	93,103,883	$102,406,507	2,357,935,605	$153,030,021	$255,436,527	2.065
50%	**186,207,766**	**$204,813,013**	**4,715,871,210**	**$306,060,042**	**$510,873,055**	**4.131**
75%	279,311,649	$307,219,520	7,073,806,815	$459,090,062	$766,309,582	6.206

It should be noted that the energy savings between this strategy and the energy retrofits are estimated to be the same on a per housing unit/commercial account basis. Their differences lie in implementation. Retrofit programs are usually supported by a mix of funding sources--some public, some private--and elicit participation from interested homeowners and businesses seeking help, financial or otherwise, to make their buildings more energy efficient. Solutions draw from a menu of energy conservation measures and technologies. Home/business owners are chosen or opt-in to retrofit programs.

Green building programs (renovation or new construction) are usually implemented by local government and become part of the existing rules and regulations that come into play when a building is renovated. A set of prescriptive standards guide which ECMs and technologies are the best fit and will meet the program standards, including energy, water savings and others. One important difference among green building programs is whether they are mandated by city code or voluntary. An increasing number of cities have begun to require that green building standards be met; this is especially the case for new construction in both the commercial and residential sectors. It should be noted that voluntary programs are usually not successful unless they are paired with incentives for the builder or property owner, such as expedited permit reviews and inspections, and fee reductions.[13]

In addition to obvious environmental benefits, they provide owners and occupants with economic, and health and community benefits, including healthier indoor air, reduced water usage, reduced pollution, resource conservation and durable maintenance materials.[14] The cost

13 The Current Status of Green and Sustainable Building Program, Standard and Code Development in the United States. Presented Allan M. Bilka, R.A., at the American Society of Civil Engineers 5th International Engineering and Construction Conference, August 2008.
14 City of Chicago Green Homes Program Guide, www.cityofchicago.org.

premium to perform green renovations in a building is, at most, just slightly higher than the cost of renovating that same building to current code regulations. A report by the Sustainable Buildings Task Force in California cited that "the average premium for all studied green buildings is slightly less than 2 percent or three dollars to five dollars per square foot."[15] The author of this study was later quoted that "more and more buildings can be built at the LEED-certified level for little or no cost premium. You can easily get at least half-way to certified at a zero-cost premium."[16] While costs and benefits will vary from project to project, national studies have shown total 20-year net benefits in the range of $50 to $65 per square foot.[17]

Appliance Trade-in Programs

Table 55. Refrigerator Trade-In Energy Savings per Unit

2040 Planning Scenario: Reinvest Energy Strategy Type: Behavior Change		
Energy Consumption, Refrigerator Trade-In	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	0	$0
Electricity (kWh)	500	$43
Emissions (MT CO2e)	0.33	n/a

Table 56. Window A/C Trade-In Energy Savings per Unit

2040 Planning Scenario: Reinvest Energy Strategy Type: Behavior Change		
Energy Consumption, Window A/C Trade-In	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	0	$0
Electricity (kWh)	221	$19
Emissions (MT CO2e)	0.15	n/a

Replacing home appliances with energy efficient ones, and in particular, refrigerators and window air conditioners, will significantly reduce energy consumption, as air conditioning and refrigeration are the two largest sources of electricity consumption in the home.
Combined, refrigerators and air conditioners make up approximately 30% of all residential electricity usage.18 These appliances almost exclusively use electricity, and typically have a relatively short lifecycles, being replaced over time for product upgrades or when repairs become too expensive of an alternative. This strategy identifies appliance replacement as an opportunity and calls for increasing the pace of replacement by aggressively targeting trade-ins for energy-efficient appliances, particularly in low-income communities that cannot readily afford new refrigerators and air conditioners.

Trade-in programs for air conditioners and refrigerators are highly effective tools to reduce electricity usage, and when implemented properly, they keep older, less efficient units from remaining in use. Appropriate rebate programs can encourage the purchase of energy efficient appliances, too. Further, as federal minimum energy standards have increased in recent years

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15 Greg Kats, Sustainable Building Task Force. The Cost and Financial Benefits of Green Buildings. October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.
16 Robin Suttel, "The True Costs of Building Green," Buildings Magazine. April 2006.
17 Greg Kats, Massachusetts Technology Collaborative, "Green Building Costs and Financial Benefits," 2003,http://www.google.com/search?sourceid=navclient&ie=UTF8&rlz=1T4HPND_en___US236&q=Green+Building+Costs+and+Financial+Benefits.
18 Energy Information Administration, Form EIA-457A, B, C, E and H of the 2001 Residential Electricity Consumption Survey.

and will likely continue to do so,[19] it will mean that most new appliances will be much more efficient than those in use today.

Despite a natural turnover rate of twenty years or less for appliances, older, inefficient appliances will remain in lower income households and in rental units largely due to affordability issues. Targeted trade-in programs provide the financial assistance necessary for overcoming lack of adoption of newer, more efficient technologies. In conjunction with trade-in programs, rebates can encourage the selection of more efficient appliances. Another red flag is the practice of putting older refrigerators in a basement or garage when a new one is purchased, and actually increasing energy use instead of decreasing consumption. Requiring the turn-in of older appliances will reduce this problem.

Window (or room) air conditioning, unlike refrigerators, is not necessarily found in every home, as window air conditioners are largely used in older buildings. Newer buildings almost exclusively have central air conditioning. Though the number of window air conditioning units will decrease naturally over time through the natural replacement rate of the housing stock, there will still be a significant number of older buildings across the region where window air conditioners are the only method of cooling air during hot summer months. Targeting this segment for trade-in programs could help reduce consumption in a major contributing sector of residential energy use.

Based on average annual consumption in the Chicago region, in a refrigerator trade-in program it is possible to reduce consumption of electricity by 500 kWh per household and reduce annual costs by $43, with an emissions reduction of 0.33 MT CO2e per unit. For an air conditioner trade-in program, it is possible to reduce consumption by 221 kWh per household with a cost savings of $19 and an emissions reduction of 0.15 MT CO2e per unit. When scaled to the region, if refrigerator trade-ins were implemented in 20% of all households in 2040, it would result in a reduction of 411 million kWh, a cumulative savings of $35 million, and a total emissions reduction of 0.274 MMT CO2e. A window air conditioner trade-in scaled to replace 20% of all housing units with window air conditioners in use in 2040 would result in a reduction of 38 million kWh, a cumulative savings of $3 million, and emissions reductions estimated at 0.026 MMT CO2e. Tables 57 and 58 show total savings for each sector if this strategy were implemented at different scales in the region.

19 Alliance to Save Energy, "Appliance Industry Joins Energy, Water Efficiency Organizations to Announce Agreement for New Minimum Efficiency Standards, Updated ENERGY STAR Levels, and Energy-Efficiency Tax Credits," http://www.ase.org/content/news/detail/3727.

Table 57. Refrigerator Trade-in Savings, % of All Households in 2040

Scale of Deployment	kWh		MMT CO2e Reduction
	Reduction	Savings	
5%	102,805,025	$8,841,232	0.069
10%	205,610,050	$17,682,464	0.137
15%	308,415,075	$26,523,696	0.206
20%	**411,220,100**	**$35,364,929**	**0.274**

Table 58. Window Air-Conditioning Trade-in Savings, % of Housing Units with Window A/C Units in 2040

Scale of Deployment	kWh		MMT CO2e Reduction
	Reduction	Savings	
10%	19,416,320	$1,669,803	0.013
15%	29,124,479	$2,504,705	0.019
20%	**38,832,639**	**$3,339,607**	**0.026**
25%	48,540,799	$4,174,509	0.032

The success of appliance trade-in programs have included one-time events or as part of a larger program, such as an energy audit or home-based appliance assessment programs. For window air conditioners, a popular model is to hold limited time events where marketing efforts encourage potential participants to pre-register for an event where they bring in their old unit and receive a new one. This ensures that old, inefficient unit is no longer in use and is properly recycled. The very nature of window air conditioners makes these programs easier to conduct, due to their non-permanent installation, and the fact that both homeowners and renters can easily participate. Air conditioner trade-in programs are best conducted in the spring before units are installed in windows for the summer. Lastly, trade-in programs, as opposed to rebate programs, are preferred because a rebate program only gives incentives to purchase a new Energy Star rated appliance, and does not involve the retirement of the inefficient unit.

Developing program guidelines for a refrigerator trade-in program is more complex than it is for window air conditioners. First, refrigerators require a more permanent installation, and the responsibility of such typically falls in the hands of the homeowner or landlord, to the exclusion of renters. Model programs include program staff that conduct home visits to inspect and measure the energy use of old refrigerators. Many use this as a basis to conduct home energy audits to identify other energy and cost-saving measures, and some provide immediate low-cost measures, such as the installation of CFLs and even low-flow showerheads in one program.

In addition to reduced energy consumption, appliance trade-in programs provide participants with reduced energy costs and in many cases, an increase in attention to energy efficiency measures.

Strategies – Preserve Scenario

Residential Retrofits

Table 59. Residential Retrofits Energy Savings per Household

2040 Planning Scenario: Preserve Energy Strategy Type: Energy in Buildings		
Energy Consumption	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	287	$336
Electricity (kWh)	2,419	$208
Emissions (MT CO2e)	3.14	n/a

Energy retrofits in existing residential buildings are a critical component to any energy reduction strategy due to the durable nature of our buildings. Residential energy efficiency programs can reduce electricity and natural gas consumption thereby reducing greenhouse gas emissions. A national evaluation of weatherization programs has shown that energy consumption can be reduced by an average 30 percent if comprehensive energy retrofits using existing technologies are implemented and equipment is maintained.[20]

Retrofit programs generally apply a mix of energy conservation measures (ECMs) and technology. Typical ECMs address building envelopes, heating, cooling, hot water, lighting systems and appliances. Technologies most often used are insulation, energy efficient windows, high efficiency boilers and furnaces, programmable thermostats or energy management systems, solar or tankless hot water systems, and compact fluorescent bulbs. The most effective programs combine technical and financial assistance to help property owners make the best choices and provide them with access to capital in order to achieve the highest savings and return on their investments.

Based on average annual household energy consumption in the Chicago region, it is possible to reduce consumption of natural gas by 287 therms and the consumption of electricity by 2,419 kWh per housing unit, which amounts to an annual household savings of $544. Emissions reductions are estimated at 3.14 MT CO2e per unit. When scaled to the region, implementing energy retrofits in half of the existing residential building stock in 2040 would result in a reduction of 294 million therms and 2.4 billion kWh for a cumulative savings of $559 million. At this scale, total emissions reductions are estimated at 3.230 MMT CO2e. Table 60 below shows total savings if this strategy were implemented at different scales in the region in 2040.

Table 60. Residential Retrofit Savings, % of Existing Housing Stock in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	58,994,575	$69,202,407	496,778,504	$42,722,951	$111,925,358	0.644
25%	147,486,439	$173,006,017	1,241,946,260	$106,807,378	$279,813,396	1.615
50%	**294,972,877**	**$346,012,034**	**2,483,892,520**	**$213,614,757**	**$559,626,791**	**3.230**
75%	442,459,316	$519,018,052	3,725,838,780	$320,422,135	$839,440,187	4.834

20 Martin Schweitzer, "Estimating the National Effects of The U.S. Department of Energy's Weatherization Assistance Program with State-Level Data: A Meta Evaluation Using Studies from 1993 to 2005," Oak Ridge National Labs, http://www.osti.gov/bridge.

Residential energy efficiency programs are cost effective, providing an excellent return on investment, and can provide benefits for households and the economy. However, implementation of a residential retrofit program at this scale will require a well-coordinated approach by local governments and service providers. Municipalities across the region could build off of existing programs that serve targeted markets, identify new program initiatives for under-served markets, and then take these programs to a much larger scale. By implementing innovative and broad strategies to make our housing stock more efficient across the region, it will become a more affordable place to live and work.

Commercial/Industrial Retrofits

Table 61. C & I Retrofits Energy Savings per Commercial Account

2040 Planning Scenario: Preserve Energy Strategy Type: Energy in Buildings		
Energy Consumption	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	2,331	$2,564
Electricity (kWh)	59,043	$3,832
Emissions (MT CO2e)	51.77	n/a

Like their residential counterpart, energy retrofits in existing commercial and industrial buildings are a critical component to any energy reduction strategy. Retrofit programs equip old buildings with appropriate energy efficiency tools and technology in order to reduce electricity and natural gas consumption thereby reducing greenhouse gas emissions. Such programs can achieve an average of 30 percent savings by retrofitting buildings using existing technologies.[21]

The retrofits address building envelopes, heating, cooling, hot water, lighting systems, and plug load. Technologies and strategies used include lighting retrofits, passive day-lighting, re-commissioning of buildings, super insulation, energy efficient windows, high efficiency boilers and furnaces, heat recovery systems, energy management systems, solar or tankless hot water systems, and high efficiency equipment to reduce plug load. The most effective programs combine technical and financial assistance to help property owners make the best choices to achieve the highest savings and return on their investments. Large commercial and industrial customers may have energy managers on staff that are able to manage consumption and electricity and gas purchase contracts.

Based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas by 2,331 therms and the consumption of electricity by 59,043 kWh per average commercial account, which amounts to an estimated annual per unit savings of $6,396. Estimated emissions reductions would amount to 51.77 MT CO2e emissions per account. When scaled to the region, implementing energy retrofits in half of the existing commercial accounts would result in a reduction of 248 million therms and 6.2 billion kWh, with a cumulative savings of $681 million in the region. Total emissions reductions are estimated 5.512 MMT CO2e. Table 62 below shows total savings if this strategy were implemented at different scales in the region.

21 Pew Center on Global Climate Change, “Working Together … Because Climate Change is Serious Business,” http://www.pewclimate.org/global-warming-in-depth/all_reports/buildings/ex__summary.cfm.

Table 62. Commercial/Industrial Retrofit Savings, % of Existing Commercial Accounts in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reductions	Savings	Reductions	Savings		
10%	49,681,635	$54,645,655	1,258,229,960	$81,659,124	$136,304,779	1.104
25%	124,204,086	$136,614,136	3,145,574,900	$204,147,811	$340,761,947	2.761
50%	**248,408,173**	**$273,228,273**	**6,291,149,800**	**$408,295,622**	**$681,523,895**	**5.512**
75%	372,612,259	$409,842,409	9,436,724,699	$612,443,433	$1,022,285,842	8.273

Commercial and industrial energy efficiency programs are cost effective, providing an excellent return on investment, and can provide benefits for individual businesses and the economy. The Building Owners and Managers Association (BOMA) states that commercial office managers in Chicago compete for long-term lease agreements by offering competitive rents and cite the importance of reducing operating costs through energy efficiency improvements. Additionally, tenants are often seeking "greener office space" to improve employee comfort and meet company goals.[22] This trend will likely continue as concern over energy prices, consumption and climate change increase.

That being said, implementation of a large-scale retrofit program will require a well-coordinated approach by local governments and service providers. Municipalities across the region could build off of existing programs that serve targeted markets, identify new program initiatives for under-served markets, and then take these programs to a much larger scale. By implementing innovative and broad strategies to make our commercial building stock more efficient across the region, it will become more affordable to conduct business in the region, in turn, more companies and small businesses will be attracted to "set up shop" here.

Updating Energy Codes

Table 63. Residential Energy Codes Range of Savings

2040 Planning Scenario: Preserve Energy Strategy Type: Energy in Buildings		
Energy Consumption	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	157 to 313	$184 to $368
Electricity (kWh)	1319 to 2638	$113 to $227
Emissions (MT CO2e)	1.72 to 3.43	n/a

Building codes provide minimum standards for the structural and mechanical safety of buildings and their systems, and are in place for the purpose of public health and sanitation. The first energy codes were developed in the 1990's by the Council of American Building Officials, and in 1998 the International Code Council (ICC) built off of this code to develop its International Energy Conservation Code (IECC). The ICC is considered the premier leader in code development and provides sample code language that can be adopted verbatim or with changes seen fit by individual municipalities. Its energy code serves as a supplemental component for standard building codes and addresses building envelope design, mechanical systems, lighting, and the use of new techniques and materials. In the 2009 IECC edition, the code "is designed to meet these needs

22 Midwest Energy Efficiency Alliance. Illinois Residential Market Analysis, Final Report. May 12, 2003.

through model code regulations that will result in the optimal utilization of fossil fuel and nondepletable resources in all communities, large and small."[23]

The State of Illinois already has energy code requirements for commercial buildings, but this is not the case for residential new construction. In a 2005 energy study in Kane County, it was found that only 6 municipalities (21%) at the time had energy codes in place, while the county was, and continues to be, a fast-growing area in our region.[24] Assuming Kane County is similar to the rest of the region, there is great potential for energy savings if municipalities begin to see the importance of adopting energy codes. It is estimated that the implementation of energy codes can reduce energy use anywhere from 15% to 30%.[25]

Considering this range of potential savings and based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas from 157 therms to 313 therms and the consumption of electricity from 1,319 kWh to 2,638 kWh per household, with an emissions reduction ranging from 1.72 MT CO2e to 3.43 MT CO2e per household annually. The annual cost savings per household ranges from $297 to $594. When scaled to the region, implementing energy codes in 25% of all new residential households through 2040 would result in a range of annual reduction between 45 million to 90 million therms and between 380 million to 761 million kWh, with a cumulative annual savings range of $85 million to $171 million. The range of total emissions reduction is from 0.491 MMT CO2e to 0.991 MMT CO2e. Tables 64 and 65 show the range of total annual savings if this strategy were implemented at different scales in the region.

Table 64. Updating Residential Energy Code Savings, % of New Construction in 2040, 15% energy savings

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	18,082,976	$21,211,874	152,272,204	$13,095,410	$34,307,283	0.196
25%	**45,207,441**	**$53,029,685**	**380,680,509**	**$32,738,524**	**$85,768,209**	**0.491**
50%	90,414,882	$106,059,370	761,361,018	$65,477,048	$171,536,417	0.991
75%	180,829,765	$212,118,739	1,522,722,036	$130,954,095	$343,072,834	1.982

Table 65. Updating Residential Energy Code Savings, % of New Construction in 2040, 30% energy savings

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	36,165,953	$42,423,748	304,544,407	$26,190,819	$68,614,567	0.392
25%	**90,414,882**	**$106,059,370**	**761,361,018**	**$65,477,048**	**$171,536,417**	**0.991**
50%	180,829,765	$212,118,739	1,522,722,036	$130,954,095	$343,072,834	1.982
75%	361,659,530	$424,237,478	3,045,444,072	$261,908,190	$686,145,669	3.954

23 International Code Council. 2009 International Energy Conservation Code. http://www.iccsafe.org/ps/pdf/3800S09.pdf
24 Community Energy Cooperative (now CNT Energy). Kane County Energy Plan. October 2005.
25 L. Kinney, "Energy Performance Workshops: Making the Integrated Design Process Fast and Effective," Boulder, Colorado: Platts.

Adopting a supplemental energy code to coincide with a municipality's standard building code has been made simple by the IECC. However, there are other considerations that each municipality may want to keep in mind, including ongoing enforcement from plan review through construction and occupancy permit processes, and regular code updates.

Strategies – Innovate Scenario

Green Building, New Construction

The U.S. Green Building Council (USGBC) defines green building as a way to "significantly reduce or eliminate the negative impact of buildings on the environment and on the building occupants" through "sustainable site planning, safeguarding water and water efficiency, energy efficiency, conservation of materials and resources, and indoor environmental quality."[26] Energy consumption and emissions can realistically be reduced by 50% over existing consumption levels in newly constructed residential and commercial buildings built to green building standards.

Table 66. Green Building Energy Savings per Household

2040 Planning Scenario: Innovate Energy Strategy Type: Energy in Buildings		
Energy Consumption, Residential	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	522	$613
Electricity (kWh)	4,397	$378
Emissions (MT CO2e)	5.71	n/a

Table 67. Green Building Energy Savings per Commercial Account

2040 Planning Scenario: Innovate Energy Strategy Type: Energy in Buildings		
Energy Consumption, Commercial	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	3,886	$4,274
Electricity (kWh)	98,405	$6,386
Emissions (MT CO2e)	8.63	n/a

Based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas by 522 therms and the consumption of electricity by 4,397 kWh for a total annual savings of $991 per newly constructed household, with 5.71 MT CO2e emissions reductions. For commercial accounts, the annual energy savings are estimated at 3,886 therms and 98,405 kWh per account, which amounts to $10,660 and an emissions reduction of 8.63 MT CO2e. When scaled to the region, green building new construction implemented in 25% of all new residential households in 2040 would result in a reduction of 150 million therms and 1.2 billion kWh, with a cumulative savings of $285 million, and a total emissions reduction of 1.652 MMT CO2e. Commercial green building new construction in half of the all new construction in 2040 would result in a reduction of 233 million therms and 5.9 billion kWh, with a cumulative savings of $639 million in the region. Total emissions reductions are estimated 5.180 MMT CO2e. Tables 68 and 69 show total savings for each sector if this strategy were implemented at different scales in the region. It is common that green building requirements take root in the commercial sector first, so the different scale of deployment between the two sectors reflects this trend.

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26 U.S. Green Building Council Atlanta Chapter web site, U. S. Green Building Council, http://www.southface.org/web/resources&services/USGBC-atlanta/USGBC-atlanta.htm.

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
25%	116,530,070	$128,173,359	2,951,223,862	$191,534,429	$319,707,787	2.590
50%	**233,060,140**	**$256,346,717**	**5,902,447,724**	**$383,068,857**	**$639,415,574**	**5.180**
75%	349,590,210	$384,520,076	8,853,671,586	$574,603,286	$959,123,361	7.760
100%	466,120,280	$512,693,434	11,804,895,448	$766,137,715	$1,278,831,149	10.350

Table 68. Residential Green Building New Construction Savings, % of Existing Housing Stock in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
10%	60,276,588	$70,706,246	507,574,012	$43,651,365	$114,357,611	0.661
25%	**150,691,471**	**$176,765,616**	**1,268,935,030**	**$109,128,413**	**$285,894,029**	**1.652**
50%	301,382,942	$353,531,232	2,537,870,060	$218,256,825	$571,788,057	3.294
75%	452,074,412	$530,296,848	3,806,805,090	$327,385,238	$857,682,086	4.945

Table 69. Commercial Green Building New Construction Savings, % of New Construction in 2040

Green building programs are almost always implemented by local government and become part of the existing rules and regulations. Typically a rating program provides a set of prescriptive standards that help guide which ECMs and technologies are the best fit in an effort to reach a designated ratings level. One important difference among green building programs is whether they are mandated by city code or voluntary. An increasing number of cities have begun to require that green building standards be met, and while often times this occurs in the commercial sector first, more green building requirements for the residential sector are also appearing. It should be noted that voluntary programs are usually not successful unless they are paired with incentives for the builder or property owner, such as expedited permit reviews and inspections, and fee reductions.[27]

In addition to obvious environmental benefits, green buildings provide owners and occupants with economic, and health and community benefits, including healthier indoor air, reduced water usage, reduced pollution, resource conservation and durable maintenance materials.[28] In a 2003 report to the California Sustainable Building Task Force, Greg Kats noted that while upfront costs to support green design are 2% higher than for typical buildings, on average, they result in a life cycle savings of 20% of total construction costs. Overall savings are more than ten times the initial investment.[29]

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27 The Current Status of Green and Sustainable Building Program, Standard and Code Development in the United States. Presented Allan M. Bilka, R.A., at the American Society of Civil Engineers 5th International Engineering and Construction Conference, August 2008.
28 City of Chicago Green Homes Program Guide, www.cityofchicago.org.
29 Greg Kats, Sustainable Building Task Force. The Cost and Financial Benefits of Green Buildings. October 2003. www.ciwmb.ca.gov/GreenBuilding/Design/CostBenefit/Report.pdf.

Behavior Change

Table 70. Residential Behavior Change Energy Savings

2040 Planning Scenario: Innovate Energy Strategy Type: Behavior Change		
Energy Consumption, Residential	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	94	$110
Electricity (kWh)	926	$80
Emissions (MT CO2e)	1.12	n/a

Table 71. Commercial Behavior Change Energy Savings

2040 Planning Scenario: Innovate Energy Strategy Type: Behavior Change		
Energy Consumption, Commercial	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	1065	$1171
Electricity (kWh)	6741	$437
Emissions (CO2e)	10.16	n/a

"Go green" is becoming the mainstream media message splashed across billboards, television ads and newspaper articles. Most adults and even children have heard about the benefits of compact fluorescent light bulbs (CFLs). A nationwide survey in 2007 polled adults and found that 52% said that the issue of global warming was either extremely or very important to them personally, with another 30% ranking it somewhat important.[30] Despite rising concerns about climate change, our actions do not reflect the scale of change needed to help solve the problem. Small but significant behavioral changes, like turning off appliances and lights, reducing cooling temperatures and heating temperatures by 3 degrees in residential properties, and using programmable thermostats to control temperatures in commercial space, have the capacity to significantly impact energy and emissions savings. Translating our concerns into personal behavioral change would have substantial impact in reducing energy consumption and greenhouse gas emissions.

This is an illustrative, and not a comprehensive, list of practical behavior changes that is meant to demonstrate how small actions can collectively make a big impact on energy consumption. In the real-life application of programs focusing on individual behavior change, individual municipalities are best suited for determining program elements that will and will not work in their respective communities. Potential behavior changes made in households include: 1) reducing heating temperature by 3 degrees; 2) increasing cooling temperature by 3 degrees; 3) turning off 3 sixty watt bulbs 2 hours per day; 4) replacing air conditioner filters; and 5) turning off appliances with a "phantom load" such as video equipment and electronics. In the commercial sector, program elements include: 1) reducing heating temperatures by 3 degrees and increasing cooling temperatures by 3 degrees; and 2) changing the thermostat to a programmable thermostat that adjusts temperatures during work and nonwork hours.

Based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas by 94 therms and the consumption electricity by 926 kWh of per household, which amounts to an estimated savings of $190 per household and an emissions reduction of 1.12 MT CO2e. For commercial accounts, per unit energy reduction are estimated at 1,065 therms and 6,741 kWh; and an estimated savings of $1,608 per commercial account, with an estimated 10.16 MT CO2e emissions reductions. When scaled to the region, if these simple behavior changes were implemented in just half of all households in 2040, it would result

30 ABC News/Washington Post/Stanford University Poll. April 5-10, 2007. N=1,002 adults nationwide. MoE ± 3. Fieldwork by TNS.

in a reduction of 193 million therms and 1.9 billion kWh, with a cumulative savings of $390 billion, and a total emissions reduction of 2.298 MMT CO2e. Similarly, these modifications to standard behavior for half of all commercial accounts in 2040 would result in a reduction of 155 million therms and 982 million kWh, with a cumulative savings of $234 million in the region. Total emissions reductions are estimated 1.476 MMT CO2e. Tables 72 and 73 show total savings for each sector if this strategy were implemented at different scales in the region.

Table 72. Residential Behavior Change, Percentage of Total Households in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
25%	96,633,755	$113,354,294	951,974,532	$81,869,810	$195,224,103	1.144
50%	**193,267,510**	**$226,708,587**	**1,903,949,063**	**$163,739,619**	**$390,448,207**	**2.298**
75%	289,901,265	$340,062,881	2,855,923,595	$245,609,429	$585,672,310	3.443

Table 73. Commercial Behavior Change, Percentage of Total Commercial Accounts in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
25%	77,579,005	$85,330,436	491,042,323	$31,868,647	$117,199,082	0.743
50%	**155,158,011**	**$170,660,871**	**982,084,647**	**$63,737,294**	**$234,398,165**	**1.476**
75%	232,737,016	$255,991,307	1,473,126,970	$95,605,940	$351,597,247	2.218

These strategies involve readily available and inexpensive technologies, and require actions that are relatively easy to adopt. Additional benefits of these behavioral changes include reduced household expenses, and reducing pollution which leads to increased health benefits. Possibly more important, behavioral change starting with minor, easy changes can develop awareness and a willingness to act that grows into an ability to embrace bigger changes further down the road.

Household Renewable Energy

Table 74. Renewable Energy Savings per Household

2040 Planning Scenario: Innovate Energy Strategy Type: Energy in Buildings		
Energy Consumption	**Energy Savings**	**Cost Savings**
Natural Gas (therms)	261	$306
Electricity (kWh)	8,795	$756
Emissions (MT CO2e)	7.25	n/a

Centralized power stations, at their inception more than one hundred years ago, provided the most efficient method for the creation and distribution of electricity. But as more fuel options and improved technologies have come to market in recent years, distributed generation (DG) of renewable energy on a household level has become a viable option. And beyond viable, DG by households is attractive for many reasons that include environmental impact, ability to address supply problems (e.g., power quality and availability), and energy security (e.g., eliminate potential for centralized electricity failure).

On-site generation of electricity allows households to decrease or even eliminate the amount of electricity purchased from the electricity grid. Appropriate household DG systems include photovoltaic (PV) panels or wind turbines that can be installed on roofs or in yards, and gas-fired micro-turbines that could be located in basements. Participating households would likely interconnect home DG systems to the electric grid in order to sell excess power, as well as purchase power when home systems do not provide sufficient capacity.

Based on average annual consumption in the Chicago region, it is possible to reduce consumption of natural gas by 261 therms and the consumption of electricity by 8,795 kWh per household for a total savings of $1,062 per year and 7.25 MT CO2e emissions reductions. When scaled to the region, household renewable energy implemented in 5% of all households in 2040 would result in a reduction of 53 million therms and 1.8 billion kWh, with a cumulative savings of $218 million, and a total emissions reduction of 1.485 MMT CO2e. Table 76 shows total annual savings if this strategy were implemented at different scales in the region.

Table 75. Household Renewable Generation, % of Total Households in 2040

Scale of deployment	Therms		kWh		Total Cost Savings	MMT CO2e reduction
	Reduction	Savings	Reduction	Savings		
1%	10,729,315	$12,585,809	361,395,484	$31,080,012	$43,665,821	0.297
5%	**53,646,577**	**$62,929,045**	**1,806,977,422**	**$155,400,058**	**$218,329,103**	**1.485**
10%	107,293,154	$125,858,090	3,613,954,845	$310,800,117	$436,658,206	2.981
20%	214,586,309	$251,716,179	7,227,909,690	$621,600,233	$873,316,412	5.962

The major barrier to distributed generation is its high initial investment costs. The cost of installing renewable electricity systems vary from $15,000 up to $50,000, with lengthy payback periods if no subsidies are involved. The State of Illinois offers rebates for alternative energy system installation, providing up to 30 percent of the installation cost.[31] The demand for these funds consistently exceeds available financing, which has resulted in only a small number of installations. While PV systems provide "free electricity," this avoided cost is very small compared to the cost of a PV system, which is approximately $6 per watt, at minimum.[32] However, Building-integrated PV systems at the time of construction are found to be much more cost-effective than retrofitted systems, and have a payback period of only 1 to 4 years.[33] Solar hot water systems are also much less expensive. To make this viable for even middle or upper income households, significant financial assistance for startup costs will likely be required.

31 Illinois Department of Commerce and Economic Opportunity, http://www.commerce.state.il.us/dceo/Bureaus/Energy/Recycling/Energy/Clean+Energy.
32 Tom LaRocque, "NREL and R&D Partners Work to Trim Solar Electricity Costs," National Renewable Energy Laboratory, http://www.nrel.gov/features/02-04_solar_costs.html.
33 P. Eiffert, National Renewable Energy Laboratory, "Guidelines for the Economic Evaluation of Building-Integrated Photovoltaic Power Systems," Golden, Colorado: January 2003